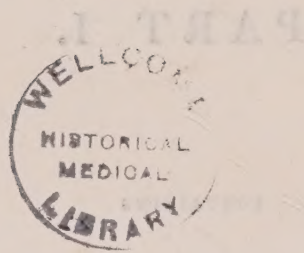


THE

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BY MARGOLIN W. HILLER

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MDCCCXXIV

TO THE MEDICAL STUDENTS OF THE BRITISH EMPIRE.

GENTLEMEN,

The difficulties which Students in general experience, in prosecuting their Studies, from the deficiencies in Anatomical Treatises, either arising out of their imperfect description of parts, or a too minute consideration of subjects that are not of the least importance, whilst those really essential are perhaps merely *alluded to*, have induced me to commence the following pages; they are difficulties which I myself at one period experienced—obliged to refer to *one work* for a description of the Bones, Ligaments, &c., *another* for that of the Muscles, a *third* for that of the Arteries, a *fourth* for that of the Nerves, a *fifth*, and perhaps a *sixth*, for those regions of the body in which the most essential parts are contained, I both *saw* and *felt* the want of a treatise that would embody all those subjects in a clear and comprehensive manner, that would serve as a *guide* to the Student, an *assistant* to the more advanced, and would, perhaps, lessen those difficulties which are so frequently met with in the course of our professional career. For the attainment, therefore, of the above mentioned objects, a full description will be given of the *Bones*, *Ligaments*, and *Articulations*, the *Classification* of *Joints*, their *Motions*, &c., the *Muscles* and those parts of importance most intimately connected with their dissection, in which will be included—the *Anatomy* of *Hernia*, the *Perinæum* in the

Male Subject, as principally connected with the *Operation of Lithotomy*, the *Relative Anatomy of the Bladder*, with reference to the operations performed on it, &c.; the *Descriptive and Surgical Anatomy of the Vascular System*, comprising the *Heart, Arteries and Veins*, the *different operations* on them, and the *accidents and operations* in which both the *trunks and branches* are principally engaged, the *Brain and Nervous System*, including the improvements of *Bell, Majendie, and Gall and Spurzheim*; the *Organs of Sense*, viz.: the *Eye and its Appendages*, including the *Anatomy of the Orbit*, its *Bones, the Muscles, Nerves, &c.*, contained in it; the *Nose*, its *Bones, Vessels, and Mucous Membrane*; the *Ear and its Appendages*; the *Skin and Tongue*; the *Fœtal Circulation*, and the *important peculiarities of the Fœtus*, viz.: the *Thymus, and Thyroid Glands*; the *Lungs before Birth*; the *Supra-Renal Capsules*, the *Membrana Pupillaris*, the *Descent of the Testicle*, the *Connexion with the Placenta*, and the *Anatomy of the Gravid Uterus*. In the accomplishing these objects, no time, no labour shall be spared, in order that the work may prove of service to the Junior Members of the Profession, be an acceptable offering to them for whose benefit it was intended, and serve as a mark of respect to those who formerly favoured me with their attendance, and who shall ever receive from me any token of esteem in my power to bestow, in return for their uniform kindness and attention.

MALCOLM W. HILLES.

Dublin, October, 1834.

THE BRITISH DISSECTOR.

PART I.

THE HUMAN BODY may be divided, for the purposes of description, either according to the *structures* which enter into its formation, or according to the several *parts* which, when united together, form it a perfect whole, and render it capable of performing those functions for which it was originally intended; the *former* division belongs especially to the province of *General* or *Structural*, the *latter* to *Descriptive anatomy*; the latter, therefore, is that which we shall adopt in the following treatise.

The *parts* which enter into the formation of the human body, are the *Bones*, *Ligaments* and *Articulations*, the *Muscles* or *Muscular system*, the *Vessels* or *Vascular system*, the *Nerves* or *Nervous system*, the *Glandular system*, etc.; to each of these is assigned a distinct office in the animal economy, yet each one

is so dependent on the other that no one part can be removed, no one part can suspend its functions for any length of time without serious detriment to the whole. The bones cannot say to the muscles, "we have no need of you," they would remain in the same state and position until time would cause their decomposition, or until some external agent, similar to muscular action, would cause their removal ; neither can the muscles say to the bones "we have no need of you," when the bones are fractured, or when they are softened as in rickets, the muscles become perfectly useless, or perhaps even injurious; nor can the vascular or other systems dispense with these seemingly less important parts. The nervous system, for example, would be destroyed were it not protected by the bones, its sources of nutrition would be completely drained, and, therefore, its energies impaired, were they not supplied by the muscles; in this way all those several parts are united together in one link of dependence, in one vast chain of sympathy, and form a whole, perfect in shape, complete in functions, and wonderful in structure; so intimately blended are they, that although a *portion* of the body may be removed, as for instance an *upper* or a *lower extremity*, etc., no one *part* can be even arrested in its functions, much less removed; thus presenting a study worthy not merely of the Anatomist, but of the Physiologist, the Natural Historian, and the Theologist, and even, in its deformities, presenting beauties for the study of the Pathologist; but let us extend our field of inquiry further;—to the original formation and ultimate decay of these different structures, and what vast sources of study are unfolded, equally interesting.

CHAP. I.

THE BONES, LIGAMENTS AND ARTICULATIONS,
OR PASSIVE ORGANS OF LOCOMOTION.

The *bones*, *ligaments*, and *articulations* constitute the *natural skeleton*, the bones alone, the *artificial skeleton*.

SECTION I.

The **BONES** are situated in the interior of the human body, and serve as a firm resisting framework, to which the other structures are attached, or in which they are contained; they also give attachment to ligaments, etc., and assist in forming the articulations; they are divided into the *long*, *flat*, and *irregular bones*.

The *long bones* are situated in the extremities, as for instance the *femur* in the thigh, the *tibia* and *fibula* in the leg, etc., where great strength and considerable motion are required; they are long in one particular direction, of a triangular shape, twisted on themselves, expanded at each extremity for the formation of the joints; and marked with eminences and depressions for the attachment of muscles, ligaments, etc.; they are hollow in the interior for the medullary canal; their structure is compact in the centre, spongy at the extremities.

The *flat bones* are placed so as to form cavities, as in the head, pelvis, etc.; they present two surfaces,

an internal concave and an external convex, are also twisted; they are thicker at the edges than in the centre; their *structure* consists of two compact laminae enclosing an intermediate cellular structure, termed the diploë.

The *irregular bones* are situated where great strength and considerable motions are required, but their motion is of a compound nature, as in the *spine*, the *tarsus*, *carpus*, etc.; they are irregular in shape, and composed of spongy, covered by a thin layer of compact tissue.

All bones cannot be comprised in these divisions, as, for example, the ribs; they resemble long bones in their length, being twisted on themselves and expanded at their extremities, flat bones in forming the parieties of a cavity and presenting a concave and convex surface, and irregular bones in their structure. The bones are supplied with blood-vessels, nerves, etc.; the former enter in the *long bones* at each extremity, and, by means of a fibrous covering they possess, termed the *periosteum*, in the centre; in the *flat bones* chiefly at their circumference, and in the *irregular bones* in different situations: nerves cannot be traced into them, yet they do possess them, as they become exceedingly painful in disease.

The *absorbents* of bone are numerous and terminate in the glands in their neighbourhood. The number of bones in the human body is variable, owing to the irregular development of small bones in the tendons where these are exposed to friction, termed sesamoid bones, and to the existence of ossa Wormiana or triquetra in the cranium; they also differ at the different periods of life; their number in the adult is estimated at 244.

SECTION II.

The **LIGAMENTS** are strong fibrous structures connecting the bones, etc., and principally situated about articulations; their fibres run in different directions, some longitudinally, others transversely, others obliquely, leaving occasionally intervals between them for the passage of blood-vessels; they present a tolerably smooth and glistening appearance; are destitute of red vessels; nerves can be only inferred to exist in them from their being painful in disease; they are exceedingly irregular in shape, size, and length, and are named from their *situation, shape, direction, attachments* or *use*; as for instance, the *lateral*, the *round*, the *capsular*, the *transverse*, the *tibio-fibular*, the *accessory* ligaments. The terms *lateral*, *round*, *transverse*, and *tibio fibular* are easily understood; by *capsular* is meant that kind of ligament which surrounds the articulating surfaces of the bones like a *capsule* or *bag*, and is only to be met with, connected with joints, as in the hip and shoulder. By *accessory* is meant some additional band of fibres, deposited in some part of the articulation, and serving to strengthen the capsular ligament, as the accessory ligaments of the same articulations.

SECTION III.

The **ARTICULATIONS** are composed of *bones*, *ligaments*, *cartilage*, and *synovial membrane*, where they enjoy any extent of motion, as in the hip, knee, ankle, etc., but, when immoveable, are composed merely of bones and ligaments, or some substance resembling those in office, as in the articulations of the bones of the head, face, pelvis, etc. The *bones*,

where they enter into the formation of the moveable articulations are expanded and covered over by a structure called *cartilage*; this forms a most important part in the mechanism of the joints; one surface of it is intimately adherent to the bone, which it covers, without having any vascular connexion, the other surface is free, smooth, and polished, and is lined by synovial membrane; at first view it appears to be one homogeneous mass, but is composed of fibres taking different directions, but principally in an oblique direction towards the bone; its chief property is that of *elasticity*, by which it is enabled to prevent the effects of shocks, and to give free motion to the joints: neither vessels nor nerves can be traced into it, excepting at the very early periods of life, when it has been stated to have been injected; their presence, however, is inferred from the effects of disease; this cartilage is thickest in the centre, when it lines a *convexity*, in the circumference, when it lines a *concavity*: it is called *cartilage of incrustation*, to distinguish it from *interarticular cartilages*, bodies of a nearly similar structure, but more fibrous, which are placed between the bones and serve nearly the same office as cartilage of incrustation, as in the knee and wrist joints, etc. The ligaments connecting these have been already sufficiently described; they do not possess elasticity. All the parts comprising the moveable articulations are lined by *synovial membranes*; this is an exceedingly thin, delicate membrane, belonging to the class of *serous membranes*; it presents a smooth polished appearance, is transparent, destitute of red vessels and nerves, at least in a healthy state, forms a shut sac, secretes a glairy, transparent fluid, termed *synovia*, which

lubricates the interior of the joint, and thus obviates the effects of friction; it is hence frequently called *joint-oil*; it cannot be demonstrated satisfactorily where it lines the cartilages, but exists distinct in other situations; it is frequently confounded with the capsular ligament. In the interior of articulations there are found, frequently, substances which were formerly called *Haversian glands*, having been supposed to secrete the synovia, by Havers, an ancient anatomist; these are merely portions of fat covered by the synovial membrane.

CLASSIFICATION OF ARTICULATIONS.

The Articulations may be classed into
COMPLETE & NON-COMPLETE.

COMPLETE, where the articulation is composed of bone, cartilage, ligaments, and synovial membrane, and admits of evident motion.

PLANIFORM.

Where the surfaces in contact are plane or nearly so, and possess the least motion.

GINGLYMUS.

{ **ANGULAR**—*perfect* where the motions are confined to flexion & extension, as in the elbow.
Imperfect where they also allow of slight lateral motion, as in the knee and ankle.

{ **LATERAL**—Where the surfaces are convex and concave, and allow of rotatory motion, as in the articulations between the radius and ulna: the odontoid process of the densata and atlas.

EN-ARTHROSIS

Where the bones present a ball and cup, or deep excavation, and where they enjoy every motion, that is, flexion, extension, adduction, abduction, rotation and circumduction, as in the hip.

ARTHROSIS

Where the bones present a ball and socket, or superficial excavation, and either enjoy every motion, as in the shoulder, or where its motions are more confined, as in the temporo, maxillary articulation, etc.

NON-COMPLETE, where the articulation is not composed of the before-mentioned structures, and where motion is either limited, or entirely wanting.

SUTURE,

Denticulated, where the bones present a serrated appearance, and are interlocked with one another, as in the sagittal and coronal sutures. *Squamous*, where they overlap, as in the squamous suture of the temporal bone.

HARMONIA

Where the bones present slightly rough substances, and are juxtaposed, as in the articulations of the superior maxillary bones.

GOMPHOSIS

Where one bone is implanted into another, as a nail is into wood.—the teeth in the alveoli are the only examples of this.

SCHINDYLESIS

Where one plate of bone is received into a groove or fissure in another, or between two other bones, as the vomer receives the azygos process of the Sphenoid bone, or is received between the two superior maxillary bones.

The above four possess no motion.

AMPHIARTHROSIS

SYMPHYSIS. Where the bones are united by cartilage, or fibro-cartilage, little motion, if any being enjoyed, as in the symphysis-pubis, the sacro-iliac symphysis, the junction of the bodies of the vertebræ.

SYNCHONDROSIS. Where the same connexion exists, but more motion is enjoyed, as between the ribs and costal cartilages.

The connexion between the *scapula* and *trunk*, and that of the *os-hyoides*, is called *sysarcosis*, but cannot be classed amongst articulations.

The motions enjoyed by articulations are, *flexion*, *extension*, *adduction*, *abduction*, *rotation*, and *circumduction*. *Flexion* is bending the joint; *extension* is the reverse of flexion; *adduction* is approximating the part to the mesial line; *abduction* is separating it from the mesial line; *rotation* is that motion in which the extremity or part moves on its own axis, that is, on a line drawn from the centre of the articulation to

the centre of the extremity of the part moved ; *circumduction* is that motion in which the limb, or part, describes a cone, the apex at the joint, the base at the distant extremity.

The SKELETON is divided into the *head, trunk, lower and upper extremities* ; this is not the order, however, we would recommend the student to study them in ; nor that which we intend to adopt ; as the *head* is the most complicated part of the human body, we think it better to commence with the *trunk*, then proceed to the *lower extremity*, then to the *upper*, and *last of all* to the *head*, and by that time the student will have become familiar with the anatomical terms, and not find the description of the bones of the head so difficult.

CHAP. II.

The TRUNK is divided into the *Spine, Thorax, and Pelvis*.

SECTION I.

The SPINE is a pyramidal column, situated at the *posterior* part of the trunk between the head *above* and the pelvis *below* ; it serves the important offices of supporting the head, thorax and upper extremities superiorly, and, resting inferiorly on the pelvis, of transmitting their weight to the lower extremities ; it also gives attachment to numerous muscles and ligaments, and affords lodgment to the spinal marrow and membranes, an important part of the nervous

system ; in its structure it combines the almost incompatible properties of *great strength, firmness, elasticity, and mobility* ; into its formation we have *entering bones, ligaments, elastic structure, blood-vessels, nerves, and absorbents.*

THE BONES OF THE SPINE.

The *bones* of the spine are twenty-four in number, and are called *vertebræ*. They are termed *true*, to distinguish them from the *false* *vertebræ* entering into the formation of the *sacrum*. They are divided into *seven cervical, twelve dorsal, and five lumbar*, not merely on account of their occupying the different *situations* indicated by their names, but from their presenting *peculiarities* in each of these regions ; we shall first give a general description of the *vertebræ*, and then proceed to consider their respective *peculiarities*.

The *vertebræ* belong to the class of *irregular* bones ; each consists of a *body*, seven *processes*, four *notches*, and a *foramen*, with the exception of the *first*, or *atlas*, which, from its peculiar shape and connexions, must receive a distinct description. The *body* of the *vertebræ* is situated at its *anterior* part, and forms its greatest portion, at least in the *dorsal* and *lumbar* regions ; its *upper* and *lower* surfaces are somewhat oval in shape, and are connected to the *vertebra* above and that below by means of the *inter-vertebral substance* ; its *anterior* surface is convex transversely, but concave from above downwards, owing to its presenting projecting lips superiorly and inferiorly, for the more intimate attachment of the *ligamentum commune anterius*, which covers this surface of the *vertebræ*, *posteriorly* it is excavated to

accommodate the convexity of the spinal marrow and its membranes, which are here in contact with it, with the intervention of the *ligamentum commune posterius*; this surface of the vertebra is exceedingly porous, owing to a number of vessels perforating it to supply the bone.

The *processes* are *seven* in number, and are connected to the *posterior edge* of the body, nearer to its *superior* than *inferior* part, by two bony plates called the *crura* of the processes, and which thus leave a superficial excavation above, a deep one below for the formation of the hole for the transmission of the spinal nerves when the vertebræ are articulated; the first of these processes we meet with going from before backwards, are the two *transverse*, projecting *laterally* and nearly in a *horizontal* direction for the attachment of muscles and ligaments, and in the dorsal region for articulating with the *tubercles* of the ribs; the next are the *four articulating*, or *oblique processes*, two *superior*, and two *inferior* for articulating with corresponding processes on the neighbouring vertebræ; the last, and which forms the seventh, is the *spinous* process, projecting very much *backwards* on the mesial line, for the attachment also of ligaments and muscles, and connected to the other processes by two thin quadrilateral plates of bone, termed the *laminæ* of the spinous processes, to the edges of which are attached the ligamenta subflava. The four *notches*, two on either side, are those already mentioned as being situated immediately *above* and *below* the *crura*, and forming the intervertebral foramina for the transmission of the spinal nerves, they are placed in front of the articulating processes, except in the first and upper surface of the second vertebra, in which they

are posterior to them. The *body* and *processes* thus connected, form the *foramen* or rather circular or oval canal, which gives lodgment to the spinal marrow and its membranes, and is hence called the *spinal canal*, the body of the vertebra bounding it *anteriorly*, the crura together with the roots of the transverse and oblique processes and intervertebral foramina *laterally*, and the spinous processes with their two laminæ *posteriorly*. These are the distinguishing marks of a vertebra. From their occupying, however, different regions in the body, and from their presenting in those regions, as before mentioned, certain characteristic marks, they have been divided into seven *cervical*, twelve *dorsal*, and five *lumbar* vertebræ, each class of which is known from the others by certain general, or as it were, family resemblances, to the consideration of which we shall now proceed, as well as to those vertebræ in each class, which, from their peculiar shape, have received a distinct description.

The CERVICAL VERTEBRÆ are known by the following marks, the *body* presents its longest axis in the *transverse* direction, its *superior* surface is concave and is bounded laterally by two projecting ridges of bone for the more perfect reception of the vertebra above. Its *inferior* surface is convex and small for the same purposes, it is of greater vertical height *anteriorly* to form the convexity of the cervical portion of the spinal column, and inferiorly overlaps the vertebra below it, for the greater security of this region, its *posterior* surface is plane; the *transverse processes* arise by two roots, the anterior one from the body of the vertebra, they are directed slightly forwards, are bifid at their extremities for the attach-

ment of numerous muscles, and are perforated near the base by the foramen for the transmission of the vertebral artery and nerves; the *articulating processes* are nearly plane, and are directed, the superior ones *upwards* and *backwards*, the inferior *downwards* and *forwards*; the *laminæ* of the spinous processes are long and narrow, the *spinous processes* stand almost *horizontally backwards* and are short and bifurcated for the insertion of muscles; the *spinal canal* is large and triangular to accommodate the spinal marrow large in this region, and to prevent its being compressed or injured by the great mobility enjoyed by the cervical vertebræ, by these characters the cervical vertebræ are distinguished from the *dorsal* and *lumbar*, but there are a few of them which, although they possess these general marks, differ from the others; these are the *first* or *atlas*, the *second* or *dentata* and the *seventh* or *last* cervical vertebra. The *first* cervical vertebra is easily distinguished; it possesses no body, but appears to be a mere ring of bone, having applied to it the articulating and transverse processes only which divide it into its *anterior* and *posterior* half-arches, the *anterior* half-arch is convex in front, and is divided into two lateral concave parts by a tubercle which affords attachment to the longi colli muscles, *posteriorly* it is concave and presents an articulating surface for the reception of the odontoid process of the second vertebra, and a small tubercle on either side, affording attachment to the transverse ligament to retain this process in situ, and which here seems to be a substitute for the body of this vertebra; its *superior* and *inferior* edges are sharp and give origin to ligaments; the *transverse processes* are situated on the same line with the oblique, they project very

much outwardly, terminating, in an obtuse point, and have the foramen for the transmission of the vertebral artery directed *upwards, backwards and inwards*, the *anterior* root by which they arise, is much stronger than the *posterior*; the *superior oblique processes* are large and concave for the reception of the condyles of the occipital bone, they look *upwards and inwards*, converge anteriorly, and are sometimes partially divided into two, by a depression on the inner edge, the inferior are circular, directed obliquely *downwards and inwards*, and are nearly plane, to roll on the superior oblique processes of the axis or dentata in the rotatory motions of the head; *behind these are the intervertebral notches*; the superior deep and directed backwards and inwards for the passage of the vertebral artery, and suboccipital nerve, the inferior also deep for the exit of the first cervical nerve, the laminae forming its posterior half-arch are long and round and are connected posteriorly without forming any spinous process, the *canal* is large and divided in the recent state into two by the transverse ligament, the *anterior* forming the articulation between the atlas and dentata; the *posterior* transmitting the spinal marrow, its membranes, the spinal accessory nerve, etc.

The *second vertebra* or *axis* has its body longer in the vertical than the transverse direction, in consequence of their arising from it superiorly the odontoid or tooth-like process for articulating *anteriorly* with the atlas or first vertebra, *posteriorly* with the transverse ligament, for which purposes it is provided with two convex articulating surfaces, one in front, the other behind, *superiorly* this process terminates in a summit or apex, from which arise the *moderator*

or *check* ligaments, and *inferiorly* is connected with the body of the bone by a neck or pedicle which is embraced by the transverse ligament, the *anterior* surface of the body is divided into two lateral concave surfaces, for one of the attachments of the longi colli muscles, the *transverse processes* are short and bifurcated, the hole for the vertebral artery is directed *upwards* and *outwards*, the *superior oblique processes* are circular, convex, and directed *upwards* and *outwards* the *inferior* are oval and look *downwards*, *forwards* and *outwards*; the *laminæ* are short, strong, and slope obliquely *outwards*; the *spinous process* is short, broad, and presents a deep groove *inferiorly*, the notch on its upper edge for the exit of the first cervical nerve is *behind* the oblique process whilst that on its inferior edge, for the second is in front of it; the whole vertebra is of a triangular shape, as is the spinal canal. The seventh *cervical vertebra* is remarkable for being large, for the non-bifurcation of its *spinous process* and its projecting posteriorly even in the living subject, where it has been mistaken for the effects of disease, for having a *foramen* in its *transverse process*, although it does not transmit the vertebral artery, for occasionally presenting the rudiments of a rib attached to its body, and for gradually approximating in its characters to the dorsal vertebræ.

The DORSAL VERTEBRÆ, or as they might be more correctly termed from their entering into the formation of the thoracic cavity as well as the dorsal region, DORSO THORACIC, are 12 in number and are known by the following characters, the *bodies* are heart-shaped, and present their longest axis in the *antero-posterior* direction, they are nearly plane on the upper and under surfaces; *anteriorly* they are convex

from side to side, concave from above downwards; their greatest vertical height is posteriorly to form the concavity of the spine forwards in the dorsal region, *posteriorly* they are concave, and *laterally* are marked on their superior and inferior edges, near to the root of the crura by two *half* articulating surfaces which with the vertebra above and beneath forms a concave excavation for the reception of the heads of the ribs, that on the *superior* edge is larger than the *inferior* one; the *transverse processes* are long, are directed upwards and considerably backwards, and have with the exception of the eleventh and twelfth, and sometimes the tenth, on their extreme end a *concave* articulating surface for the *tubercles* of the ribs, the *oblique processes* are vertical and are directed, the superior *backwards*, the inferior *forwards*, the *laminæ* are broad and flat, the *spinous processes* are *much longer* than those of the other vertebræ but project least in consequence of their great inclination downwards so as to overlap one another and prevent motion in this region; they are triangular, present a sharp spine *superiorly* and a groove *inferiorly* for alternately receiving and being received into each other, and terminate *posteriorly* by a large knob or eminence, the *canal* is small and circular and so closely invests the spinal marrow that disease in these is rapidly propagated from one structure to the other. The *dorsal vertebræ* which differ materially from the rest are the first, tenth, eleventh, and twelfth. The first *dorsal vertebra* is long transversely, and has latterly a *whole* articulating surface near its *superior* edge for the first rib, a *half* one *inferiorly* for the upper part of the head of the second, its *spinous process* is long, of considerable strength and projects almost horizontally backwards. The tenth,

eleventh and twelfth have a *whole* articulating surface on their *bodies* for the heads of the corresponding ribs, their *transverse processes* are comparatively short and want (with the exception sometimes of the tenth), the articulating surfaces for the tubercles of the ribs; the twelfth is still further characterised by its *inferior oblique processes* suddenly taking the direction of those of the *lumbar* vertebræ that is outwards, and by its general resemblance to these vertebræ. The student may remark that the dorsal vertebræ do not, like the cervical and lumbar increase regularly from above downwards, they first decrease as far as the fourth and fifth, which are much smaller than the rest and then gradually increase. The *lumbar vertebræ*, to which we would give the term *lumbo-abdominal* from their bounding posteriorly the *abdominal* cavity, are five in number, and are the largest in the spinal column; the *body* is remarkable for its great transverse extent, it is concave from above downwards, convex transversely and is of greater vertical height *anteriorly* than *posteriorly*, its superior and inferior surfaces are flat, the *transverse processes* are long and slender, and stand almost directly outwards, those of the third and fourth being longer than the others; the *superior oblique processes* are concave, widely separated from one another and look directly *inwards*, the *inferior* are the reverse; the *laminæ* are short and thick and project beyond one another by their inferior edge, the *spinous process* is broad, flat, and quadrilateral, terminates by a long vertical prominence, and projects directly backwards—the *spinal canal* is again large and triangular as in the cervical region. In the lumbar region the *last vertebra* only deserves distinct consideration; its *body* is cut off *inferiorly* with

a great degree of obliquity to form the promontory of the sacrum on which it rests, the *transverse processes* are short and thick, the *inferior oblique processes* are slightly convex, and look forwards and outwards and *its spinous process* is short and rounded. The student will no doubt have observed that it is only in the *centre* of the respective regions that he meets with those distinguishing marks laid down as characteristic of the different vertebræ; according as we pass from this towards either extremity, they gradually merge into the characters of the regions which they approach. The *structure* of the bodies of the vertebræ is principally spongy with a thin layer of compact tissue externally, which accounts for their great liability to caries, familiarly known by the name of Pott's disease of the spine. The *spongy structure* is not so extensive in the cervical region as in the dorsal and lumbar, the *processes* are almost wholly composed of *compact* tissue, which preserves them from destruction although the bodies may be completely removed. The vertebræ are *developed* by three centres of ossification, one for the *body* and two for the *processes*, with the exception of the first cervical vertebra or atlas which possesses five, one for the anterior half-arch, two for the posterior, and two for the lateral masses, and the second or dentata which has an additional point of ossification for the odontoid process.

THE LIGAMENTS OF THE SPINE.

The *vertebræ* are connected together by strong and powerful ligaments, and a peculiar structure termed the *intervertebral substance* or *cartilage*, with the exception of the first and second cervical which are

connected to the occipital bone and to each other by a peculiar set of ligaments intended to allow of the motions which these parts enjoy, distinct from the rest of the spinal column. The *last lumbar vertebra* too, is connected to the *sacrum*, but only by the same ligaments as stretch from vertebra to vertebra.

We shall first describe the articulations and ligaments between the atlas and dentata, and occipital bone, and then consider the proper connecting media of the vertebræ with each other. To expose the articulation between the *occipital bone*, and *atlas*, and *dentata*, it is necessary to remove the *posterior* part of these bones by a vertical incision carried downwards to the third cervical vertebra through the centre of the foramen magnum, and then take away the upper part of the spinal marrow and its membranes; on doing this and removing some loose cellular membrane, the *first* of these ligaments and which conceals the rest from our view will be exposed, this is the

Apparatus ligamentosus colli; this is a broad, flat, ligament, arises *superiorly* from the *anterior* edge of the foramen magnum, near the cuneiform process of the occipital bone, passes *downwards* and *backwards*, and is inserted into the *posterior* surface of the body of the *second vertebra* or *dentata*, from which it descends to be continuous with the *posterior common ligament* of the spine. In this course, the *posterior* surface of the *apparatus ligamentosus colli* is covered by dura mater, its *anterior* surface corresponds from above downwards to the anterior edge of the foramen magnum, to the moderator or check ligaments, to the apex of the odontoid process, and to the transverse ligament to which it is

slightly connected by cellular substance ; by raising it we expose the *check* and *transverse ligaments* ; the *former*, also called *moderator*, arise one on either side from near the summit of the odontoid process, pass almost *transversely outwards*, with a slight degree of obliquity *upwards*, and are inserted into the internal edge of the foramen magnum, near the anterior extremity of the condyles of the occipital bone ; their *use* is not only to connect the second vertebra with the occipital bone, but also to *moderate or restrain* the rotatory motions of the head, whence they have received their name ; the *right* check ligament prevents the head being rotated too much to the left side, and the *left* the contrary motion.

The *transverse* ligament, arises from the eminence observed on the inner edge of the atlas in front of the superior oblique process, passes *transversely* across the *head* of the odontoid process, encroaching a little on its neck and is inserted into the eminence on the opposite side ; this ligament is by some described as of a crucial shape, sending a prolongation upwards to the edge of the foramen magnum, and another downwards to the body of the second vertebra ; although not exactly perhaps of this shape it is always more expanded in its centre than at its extremities ; its structure is very remarkable, approaching to that of *fibro-cartilage*, and in some instances presenting in its centre, where it is exposed to the motions of the odontoid process, an osseous, or cartilaginous deposit.

Besides those ligaments, the *atlas* is connected to the occipital bone by an *anterior* and *posterior broad ligament* which arise from the upper edge of the atlas, and are inserted into the corresponding

edges of the foramen magnum, the *posterior broad ligament* is perforated by the vertebral artery and the suboccipital nerve; capsular ligaments also surround the articulations between the condyles and the superior articulating surfaces of the atlas, and the articulation between its *inferior articulating* process and the *superior* of the dentata. All these articulations are lined by synovial membrane, the odontoid process alone having *two* distinct synovial sacs, *one* between it and the atlas, and the *other* between it and the transverse ligament. The articulation between the *occipital* bone and *atlas* belongs to the class *Arthrosis*; that between the *Atlas* and the odontoid process of the *dentata*, to *Lateral Ginglymus*. Their *motions* are perfectly distinct from those of the spine; they, in fact, more properly belong to those of the head; they are those of assent and dissent; the *former* is performed between the *condyles* of the occipital bone, and the atlas, and is effected by the alternate elevation and depression of the head; the *latter*, or, as it is also called, the *rotatory motion*, takes place by the *head* and *atlas* rolling round the odontoid process of the second vertebra. Nature has thus rendered these important articulations more secure by dividing their motions.

The student may now explain the serious consequences that so frequently ensue from disease or accidents occurring in these articulations; death has been known to occur instantaneously in cases where the check ligaments have been ruptured, as in the foolish experiment of showing children London or Paris; in the execution of criminals, &c. the odontoid process slips from beneath the transverse ligament, the head falls forwards, and the spinal marrow is com-

pressed against the posterior part of the spinal canal ; the same results occur in disease of the anterior half arch of the atlas from long continued ulceration of the back of the pharynx, nay, the *vertebral artery* itself from its contiguity to the disease has been opened and death produced by the sudden effusion of blood into the spinal canal. The remainder of the *vertebræ* which enter into the formation of the spine are connected together by the *anterior and posterior common ligaments*, the *intervertebral substance* and the *ligamenta subflava* : besides these there are other ligaments but not of much importance which from their connexion with the *transverse* and *spinous processes* have been called, *inter transverse*, *inter spinous* and *supra spinous* ligaments, there are also capsular ligaments surrounding the articulations between the oblique processes of the *vertebræ*.

The *anterior common ligament* also called the *anterior vaginal* or *intervertebral ligament*, is situated on the *anterior* part of the spine ; it arises *superiorly* from the anterior surface of the body of the second vertebra and, stretching from vertebra to vertebra, terminates by being expanded on the anterior surface of the *sacrum* and *os coccygis* : in this course the anterior common ligament is firmly attached to the edges of the bodies of the *vertebræ* and to the *intervertebral substance*, but is loosely connected to the centre of the *vertebræ*, being separated from it by vessels which pass in there in considerable number to supply the bone ; its fibres consist of a superficial, middle, and deep set, the first stretching between three or four *vertebræ*, the second from one vertebra to another, and the third from the vertebra to the *intervertebral substance*. This ligament

increases in breadth as it descends, but is thicker in the dorsal than in the cervical and lumbar regions, its edges are not distinctly marked but are gradually lost in cellular substance on either side, it is not at all dense in its structure, being perforated by numerous vessels. It receives additional strength in the *cervical* and *dorsal* regions from the tendinous organs of the longi colli muscles; *in the lumbar* from the pillars of the diaphragm: its *use* is to prevent too great extension of the spine as well as to connect the bodies of the vertebræ together.

The *posterior common, vaginal* or *intervertebral ligament* is situated in the *interior* of the spinal canal forming its *anterior* boundary. To expose it we must saw through the crura of the processes and remove them together with the contents of the canal; it may be now seen to arise *superiorly* from the posterior surface of the body of the *second vertebra* extending along the whole length of the spinal canal and finally to be inserted into the upper part of the sacrum, *superiorly* this ligament is continuous with the *apparatus ligamentosus colli*, *inferiorly* it is connected with the periosteum of the sacrum, between these two points it takes firm attachment to the edges of the vertebræ and especially to the *intervertebral substance* where it expands considerably, to prevent the substance here almost fluid from being forced back on the spinal marrow in the motions of the spine; opposite the bodies of the vertebræ it is completely separated from the bone by numerous vessels entering here to supply the spongy structure, its edges are lunated and well defined, its structure is dense and firm, and it presents a smooth glistening appearance. This ligament, it may be

seen differs from the anterior in many particulars, it is much more dense in its structure, its edges are well defined, it is more glistening in its appearance, expands considerably opposite the intervertebral substance, and is not attached to the centre of the vertebræ. Its *use* is to resist too great flexion of the spine, to connect the bodies of the vertebræ together *posteriorly* and to preserve the *spinal marrow* from pressure, it is but little affected in the motions of the spine.

The *intervertebral substance* is a fibro-cartilaginous structure situated between the bodies of all the vertebræ (except the *atlas and dentata*,) and also between the last lumbar vertebra and the sacrum, and deserves the particular attention of the student, from its performing other offices than that of a connecting medium between the vertebræ. It is of trifling extent in the *cervical region*, increases in the *dorsal*, but it is best marked in the *lumbar region*, it is so firmly connected to the bodies of the vertebræ, that force applied will rather break the bones than separate this substance from them, its *vertical height* is greater *anteriorly* between the *lumbar and cervical* vertebræ to form the convexity of the spine in these regions, but greater *posteriorly* between the *dorsal* vertebræ as the spine is here concave, its fibres at first view appear to be concentric, but on a closer examination will be found to decussate with one another, as may be best seen by scraping a portion off it anteriorly; on making a transverse section of it, it will be found tolerably dense at the circumference; but as we approach the *centre* it presents a pulpy semifluid structure near the vertebral canal, and directly in the *centre* of the *whole* vertebra,

although nearer the posterior than the anterior part of the *body*. This pulpy substance is of greater extent in the centre of the intervertebral substance, than near the bones, whence it is of a diamond shape, and is said to perform the office of a fluid pivot, round which the motions of the vertebræ are performed.

The *intervertebral substance* is exceedingly elastic in its nature, and has, for its office, not only to connect the bodies of the vertebræ together, but also, from its elasticity, to preserve the spine from the effects of shocks; in the upright position it undergoes considerable compression, hence our height is greater in the morning than in the evening.

The *ligamenta subflava* are situated at the posterior part of the spinal canal, and occupy the interval between the *laminæ* of the *spinous processes posteriorly*. They consist of twenty-three pair; the first pair being situated between the second and third *cervical vertebræ*, the last between the last *lumbar* and the *sacrum*; they are best seen in the *lumbar* region, being but badly marked between the cervical and *dorsal vertebræ*; in the *latter* region, owing to the close approximation of the *laminæ* of the spinous processes, and the little motion enjoyed by them; in the *former* to their place being supplied by muscles. They are best seen in the section the student has already made to expose the *posterior common ligament*, by examining the *posterior* part of the vertebræ which he has removed, on its *internal* surface. Each *ligamentum subflavum* is of a quadrilateral shape, its *superior* edge is attached to the lamina of the vertebræ above, its *inferior* to the edge of the lamina below, a little on its internal surface; its *posterior* edge

approaches to that of the opposite side, and thus leaves a triangular interval filled in the recent state with a quantity of reddish reticular cellular tissue ; its *anterior* forms the posterior boundary of the foramen for the transmission of the spinal nerves ; one of its surfaces looks *forwards and inwards* towards the spinal canal, the other in the contrary direction. This ligament is of a yellowish colour, from which it has received its name ; its structure is exceedingly dense, firm, and elastic, resembling the yellow tissue in the middle coats of arteries, and, like this structure, becomes red on exposure to air ; its use is to connect the laminæ of the vertebræ together, to protect the spinal canal posteriorly, and, from its great elasticity, to allow of flexion of the spine, and, also by its re-action to assist in its extension.

The rest of the *ligaments* of the spine are comparatively unimportant, and only exist in the dorsal and lumbar regions, their place being supplied in the neck by muscles, and by the ligamentum nuchæ. They consist of the *supra spinous ligaments*, extending from the apex of the spinous process of the last cervical vertebra, to the tubercles on the back part of the sacrum, where they are connected with the other ligamentary structures covering this part ; in this course they are attached to all the spinous processes, connecting them together, and preventing their too great separation in the motions of the spine, they are better marked in the lumbar than in the dorsal region. The *interspinous ligaments* are situated as their name implies, *between* the *spinous processes*, they extend from the spinous process of the last cervical vertebra to the sacrum, occupying the intervals between the spinous processes, they are exceedingly

thin and weak in the *dorsal* region, owing to the overlapping of those processes in this situation, but are strong and well marked in the *lumbar*; *anteriorly* they correspond to, and are slightly connected with the posterior edges of the ligamenta subflava, *posteriorly* they are covered by the preceding ligaments, *laterally* they are concealed from view by the lumbar mass of muscles; their use is the same as the preceding. The *intertransverse ligaments* are a few indistinct fibres stretching between the transverse processes of the dorsal and lumbar vertebræ as they are described by some anatomists, others state that they only exist from the fifth to the eleventh dorsal vertebræ. Besides these ligaments we have *capsular ligaments* surrounding the articulations between the oblique processes of all the vertebræ, lined by synovial membrane; they do not deserve a minute description. These Articulations belong to the class Planiform.

By the junction then of those different parts, the vertebræ, the *intervertebral substance*, and the *ligaments*, the *spinal column* is formed and presents as a whole, many interesting points for observation. We shall view it in its different aspects, *anteriorly*, *posteriorly*, and *laterally*, and point out the different features which each surface presents, worthy of remark. Before doing so, we may observe that the *atlas* or *first vertebra* must be excluded, as, from its several peculiarities already mentioned, the great projection of its *transverse processes* laterally, and the connexion of its motions with those of the head already considered, it cannot possibly be included in a general description of the spine.

On viewing the spine *anteriorly*, that is, placing the *anterior* surface of the bodies of the vertebræ directly

before us, it appears, on a superficial examination, to be of a pyramidal shape, its *apex* at the *second cervical vertebra*, its *base* at the junction of the last *lumbar vertebra* with the *sacrum*; on closer examination, however, it will be found, owing to the projection of the transverse processes of the *cervical* vertebræ, the gradual diminution in size of the *dorsal* as far as the fourth, and then the gradual increase again to the *sacrum*, to consist of three pyramids, the first having its *base* at the *sacrum*, its *apex* at the fourth *dorsal vertebra*; the second an inverted one, having its *apex* here at the fourth *vertebra*, its *base* at the seventh *cervical*, the third commencing here, which forms its *base*, and terminating in an *apex* at the second *cervical vertebra or dentata*. The spine, on this aspect, is not perfectly straight, but inclines a little to the *right* side, from about the third to the sixth dorsal vertebra, having its concavity turned towards the *left* side; this was formerly considered to be owing to the pulsations of the thoracic aorta which lies in contact with these vertebræ, but has more recently been found to be caused by the more frequent use of the right hand, and, accordingly, presents, in left-handed persons, its concavity and convexity in the contrary directions. This natural curve should not be mistaken for disease. The *posterior surface* of the spine presents the row of spinous processes on the mesial line, projecting horizontally backwards in the *cervical* and *lumbar* regions, drooping considerably, so as to overlap one another in the *dorsal*, for the prevention of its motion and its greater security, and having here a slight convexity towards the right side. On each side of these a deep groove, bounded externally by the oblique and transverse processes, and formed by the laminæ of the vertebræ here

separated from one another by an interval, large between the cervical and lumbar, small between the dorsal vertebræ, through which an instrument may be passed into the spinal canal, and which is occupied by the ligamenta subflava; in this groove which decreases in breadth, but increases in depth from above downwards, is lodged the lumbar mass of muscles. The *spine*, when viewed *laterally*, presents an undulating line *convex* forwards in the *cervical* and *lumbar* regions, to support the pharynx, etc., in the first, the abdominal viscera in the second; but *concave* in the *dorsal* to increase the capacity of the thorax in the *antero-posterior* direction; the greatest convexity is in the middle of the lumbar vertebræ; in this view of the spine we see, besides the bodies of the vertebræ and the intervertebral substance, the foramina for the transmission of the spinal nerves, formed between the crura of the processes above and below, the intervertebral substance in front, and behind by the anterior edge of the ligamenta subflava and the oblique processes; these foramina are in *front* of the *transverse processes* in the *back* and *loins*, but rather *between* them in the *neck*.

The *spine* is traversed through its whole length, a little *posterior* to its centre by the *spinal canal*, for the lodgement of the *spinal marrow* and its membranes; this is formed *anteriorly* by the posterior surface of the bodies of the vertebræ, and intervertebral substance, covered by the posterior common ligament, *posteriorly* by the laminæ of the spinous processes, the ligamenta subflava, and the roots of the spinous processes, and *laterally* by the crura of the processes, and the foramina already described, for the transmission of the spinal nerves; it is large and triangular in the *cervical* and *lumbar*, but small and

circular in the *dorsal* regions, to correspond with the size of the nervous structure contained in these situations; it is continuous *above* with the cavity of the cranium, *below* with that of the sacrum.

The spine enjoys considerable motion, *flexion*, *extension*, *lateral motion*, *circumduction*, and *rotation*. By *flexion* is meant the bending forwards of the spine; it may be performed without any muscular effort, as the great weight of the head anteriorly, and the cavities of the thorax and abdomen with their contents, produce a constant tendency in the spine to bend in this direction, as may be exemplified by the inclination of the body forwards when sleeping in the erect position, in drunkenness, etc. This action is also produced by the contraction of the abdominal muscles anteriorly, the *longi colli*, etc.; in it, all the ligaments of the spine are stretched, excepting the *anterior common ligament* which is relaxed, the *intervertebral substance* is forced backwards towards the spinal marrow. Flexion of the spine backwards may take place by the contraction of the lumbar muscles, but is not a natural action; the reverse of flexion forwards takes place in it with respect to the ligaments and intervertebral substance. *Extension* of the spine is bringing it to the erect posture, and is produced principally by the contraction of the *lumbar muscles*, and the *psoas magnus*, aided by the *resiliency of the intervertebral substance*, and the *ligamenta subflava*. *Lateral motion* is inclination to either side, and is effected by the alternate contraction of the muscles of the right and left side. *Circumduction* of the spine is very extensive as is evidenced by revolving on the tuberosities of the ischia, in this motion the apex is at the pelvis, the base at the head; it is a compound of the preceding motions. *Rotation* is

exceedingly limited and even denied by some ; it is more a twisting of the intervertebral substance than real rotation ; of course we except the rotation enjoyed by the head, and first vertebra on the odontoid process of the second. The centre of motion in each vertebra is referred to the pulpy structure in the interior of the intervertebral substance.

The SPINE, thus formed, and presenting these several features, resting on the sacrum *inferiorly*, and through it, and the pelvis, on the lower extremities, has, perhaps, the most numerous and important duties to perform of any part of the human body ; it does not, as a *column*, merely support the head *superiorly*, the upper extremities, the thoracic and abdominal cavities, with their contents *anteriorly*, nor, as a mere hollow cylinder, give lodgement to the spinal marrow, but has the additional offices of preserving all those parts from the effects of violent shocks, so likely to be transmitted to them from the extremities, and of being the centre of almost all the motions of the body, and yet it must, at the same time, easily maintain the erect posture, and be sufficiently secure from any displacement of its component parts. For these purposes Nature has admirably adapted it. For the *first* of these offices, it is formed of *several* bones connected by *elastic* structures, viz : the *intervertebral substance* between the *bodies* of the vertebræ, like so many air, or spring cushions, and the *ligamenta subflava* between the laminæ of the spinous processes, and it is so bent in different directions that the force of shocks transmitted from the lower extremities is completely broken by the *alternate yielding* of each curve. For the *second*

it is possessed of several articulating surfaces, in order that it may move in every direction. For the *third*, the *curves are* thrown in such a direction as that the weight supported, falls directly *in the centre of support*, and it has attached to its posterior part, where they are most required, powerful muscles. And for the *fourth*, although the component parts be numerous, they are locked firmly into one another, and are connected by powerful structures; although it possess articulations, and enjoy extensive motions, the former are so numerous that but little motion is enjoyed between any two vertebræ, and they are so surrounded on all sides by bones, muscles, etc., that a direct serious injury of the spine is *comparatively* rare.

The *bones of the spine* are formed of *compact* and *spongy* tissue, the former predominating in the *processes*, the latter in the *bodies*, from which they are very liable to caries; the *intervertebral substance* is fibro-cartilaginous, exceedingly elastic, and possesses but little vascularity or sensibility—in caries it is equally affected with the bodies. The *ligaments* belong to the class of *fibrous membranes*, excepting the *ligamenta subflava*, which resemble the yellow tissue more from the several peculiarities mentioned. These parts are supplied with blood from the arteries in the neighbourhood; in the *neck* from the *vertebral* and *cervicalis profunda* arteries, in the *back* from the *intercostal*, and from the *lumbar arteries* in the *loins*: they enter the bones principally at the *posterior surface* of the bodies: the veins which return the blood are called the *vertebral veins* or *sinuses*, and open into the *lumbar veins*, the *vena azygos*, and the *subclavian* and *jugular veins*; no nerves can be distinctly traced into the vertebræ.

The spine is liberally supplied with *absorbents* which terminate in the *greater* and *lesser thoracic ducts*.

The spine of the *Fœtus* differs much from that of the adult—its bones consist of several points of ossification as already mentioned, and are small in proportion to the other structures ; its *intervertebral* substance is large in quantity and contains more of the pulpy structure ; its *ligaments* are weak, the *canal* is short but large as are also the *holes* for the exit of the nerves : its *shape* is pyramidal, the *base* above, the *apex* below ; it possesses but *one* curve, concave forwards : the cervical region is better developed than the dorsal, this better than the lumbar. The spine is early formed in the fœtus, appearing in the third week. The spine in the old subject resembles that of the fœtus in being throughout concave forwards—its elastic structures lose much of their elasticity and are frequently converted into bone.

SECTION II.

THE THORAX.

The *Thorax* is a large conical cavity, situated at the *upper* and *anterior* part of the trunk, for the lodgement of the *heart*, *lungs*, *large blood-vessels*, etc., and composed of bones, cartilages, ligaments, vessels, &c : it is formed *posteriorly* by the dorso-thoracic vertebræ, and the ribs, as far outwards as their angles, *laterally* by the bodies of the ribs, and *anteriorly* by the anterior extremities of the ribs, the sternum and costal cartilages.

THE BONES OF THE THORAX.

The *Bones* which enter into the formation of the thorax are the *dorsal vertebræ*, the *ribs*, and the *sternum*.

The *vertebræ* have been already described.

The *Ribs* consist of twenty-four irregularly-shaped bones, twelve on each side, placed, as already mentioned, in the *posterior*, *lateral*, and *anterior* regions of the thorax, extending from the *vertebræ posteriorly* to within a short distance of the *sternum anteriorly*, varying in length as we examine them from above downwards, *increasing* from the first to the eighth, and then *diminishing*; in *breadth*, they, on the contrary, diminish progressively from the first to the last, although not regularly so: they are divided into seven superior *true* and five inferior *false ribs*, or, more properly, into *sternal* and *asternal*, in consequence of the former being *directly* connected to the *sternum* by their cartilages, the *latter* only through the intervention of the cartilage of the last true rib, with the exception of the last two which have no connection with the *sternum*, but lie loose between the abdominal muscles, and are hence termed the *floating ribs*. The ribs are exceedingly irregular-shaped bones; they present their long axis in the antero-posterior direction, are expanded at their extremities, and are twisted at different parts in such a way as not to rest even on a horizontal plane; they consist of a *head*, *neck*, *tubercle*, a *body*, and an *anterior extremity*. The *Head* of the rib is situated at its *posterior* or *vertebral* extremity and presents itself as a somewhat round, though rather irregular, eminence, divided by a horizontal ridge into two articular surfaces (of

which the *superior* is the smaller) for connection with two dorsal vertebræ, the ridge itself being received into the interval between them, and here firmly connected with the intervertebral substance. The *Neck* of the rib is a process of bone extending from the head to the tubercle; it is round, of considerable length, and is directed downwards, backwards and outwards: it gives attachment to the *inferior costo-transverse* ligament and occupies, when in situ, the interval between the bodies, and the extremities of the transverse processes, of the vertebræ; next is the *Tubercle*, this is a rounded eminence, situated on the *posterior* surface of the rib, near its inferior edge, looking downwards and backwards, it is divided into an internal *articular*, and an external *non-articular* portion, the *former* smooth and convex, articulates with the summit of the transverse process of the vertebra beneath; the *latter* is rough for the attachment of the posterior *costo-transverse ligament*. The *Body* of the rib commences at its tubercle and terminates at the anterior extremity; it presents for examination an *outer* and *inner surface*, an *upper* and *lower* edge. The *outer surface* of the rib is convex, and is directed a little upwards; on it we perceive as we pass outwards from the tubercle, a rough surface, of variable length in different ribs, *increasing* from the first to the ninth, and then *diminishing*, for the insertion of the longissimus dorsi muscle; then the *angle* forming a remarkable protuberance posteriorly, and presenting a sharp ridge, directed obliquely downwards and outwards for the insertion of the sacro-lumbalis muscle; the angle is wanting in the first and twelfth ribs, and but badly marked in

the second and eleventh, from this *forwards* the outer surface of the rib is smooth and convex, and is covered in the recent state by numerous muscles, the *pectorals*, the *serrati magni*, etc.; the *inner surface* of the rib is concave, directed downwards and inwards, and is covered in almost its whole extent by the pleura; the *upper edge* is rounded off, is directed a little inwards, gives insertion to the intercostal muscles, its inferior edge, turned outwards, is sharp and grooved posteriorly for the intercostal artery, and gives origin to the intercostal muscles; its *anterior* extremity is hollowed out for the reception of the costal cartilage. The rib from its *head* to its *angle* inclines *downwards, backwards* and *outwards*, then turns *forwards*, and descends with a considerable degree of obliquity, especially in the lower ribs, to meet the costal cartilages.

The *True ribs* are distinguished from the *False* by their being more arched, by the greater expansion of their sternal extremities, (the false tapering to a point,) by their *angle* being more prominent, and by the *inferior* articular surfaces on the heads of the false being much greater than the *superior*. The *first, second, eleventh, and twelfth ribs*, present some peculiarities which must be considered. The *first rib* is much shorter than any of the rest; it is broad, thin and flat, placed nearly horizontally, and is regularly curved, so as to form nearly a semi-circle, and to allow its extremities to rest, at the same time, on a horizontal plane; its *head* is not divided into two articular surfaces, but articulates with a whole surface on the body of the first vertebra, the neck is of considerable length; it wants the angle, its surfaces are directed upwards and downwards,

the superior of which presents two depressions corresponding to the subclavian artery and vein, separated by a ridge into which is implanted the scalenus anticus muscle, its upper, or rather inner edge, does not give attachment to the intercostal muscles. The *second rib* resembles the first; it is, however, longer, and altogether seems to be intermediate in peculiarities between the first and the succeeding ribs. The *eleventh and twelfth*, called also the *floating ribs*, from their anterior extremities not being connected with the sternum, but floating, as it were, between the abdominal muscles, are short and thin; the *head* presents a whole articulating surface for the body of the corresponding vertebra, they want the *tubercles* as they do not articulate with the *transverse processes*, the *angle* is badly marked in the eleventh, completely deficient in the twelfth; their anterior extremities thin and pointed are in general tipped with cartilage. The lower edge of the last rib gives attachment to some of the abdominal muscles, but not to the intercostals. The tenth rib occasionally resembles the eleventh and twelfth, in being articulated with but *one* vertebra, and not articulating with the transverse process.

The *Sternum* is the symmetrical bone which we may observe to be situated in the *anterior* part of the thorax on the mesial line, broad and thick *superiorly*, narrow in the *centre*, and rounded off at its inferior extremity, it is placed *obliquely* in the thorax, so that its *upper* extremity is on a plane *posterior* to the *lower*; the *anterior* surface of the sternum is rough, and covered by the aponeurosis from the great pectoral and sterno-mastoid muscles, and the anterior sterno-clavicular ligament, it is

marked with four transverse lines, pointing out its original division into five pieces; the two *superior* of these lines are better marked than the two *inferior*, its aspect is upwards and forwards, in it we occasionally perceive a small *foramen*, the use of which is unknown; nothing important passes through it: the *posterior* surface of the sternum is smooth and concave, and forms the anterior boundary of the anterior mediastinum, it presents the four transverse lines already described; *superiorly*, it gives origin to the *sterno-hyoid*, and *thyroid* muscles, and the *posterior sterno-clavicular ligament*, it gives attachment *inferiorly* and *laterally* to the *triangularis sterni* muscle; the *superior* extremity of the sternum is thick and excavated transversely, especially on its posterior edge for accommodating the trachea, and the inter-clavicular ligament, and presents *laterally* two cartilaginous surfaces, small and superficial, concave from above downwards, convex antero-posteriorly, and directed backwards and outwards, for the sternal extremity of the clavicle; the *inferior* extremity is the narrowest part of the sternum, and has attached to it a cartilaginous body exceedingly irregular in size, direction and shape, termed the *xiphoid* or *ensiform cartilage*, which gives attachment to the linea alba, and the costo-xiphoid ligament, it is occasionally bony in the old subject; the *lateral* edges of the sternum are thick, and possess seven concave articulating surfaces on each side for the reception of the cartilages of the true ribs, they are separated by a considerable interval above, but inferiorly approach one another, so as that the sixth and seventh are sometimes not more than a line asunder, the superior of these is circular, and has its cartilage continuous

with that of the first rib, the rest are a little quadrilateral, and are surrounded by a prominent ridge of bone, better marked in the young than in the old subject, as they correspond to the transverse lines already described ; and which are less prominent in the latter periods of life. The sternum in the adult is formed of two pieces, the *superior* of which is short, broad and triangular, the base turned upwards, the apex downwards, it is marked *laterally* with the excavation for the first rib, and a half one for the second, and is connected to the *inferior* piece by a cartilaginous structure allowing of a slight degree of motion, excepting in the old subject, in which it is most frequently ossified. The *inferior* piece is long and narrow, tapering towards each extremity, and presents on *each side* the corresponding half articular surface for the second rib, and five whole ones for the inferior five true ribs ; the last of these is sometimes completed by the xiphoid cartilage.— In the foetus, the sternum consists of five pieces.

The *Costal Cartilages* complete the thorax *anteriorly*, and are extended between the ribs and the sternum ; they are twelve in number on each side ; of these the seven superior only are directly connected with the sternum, the three succeeding are connected with the cartilage of the last true rib, and with one another, whilst the last two are suspended in the abdominal muscles—they *increase* in length from the first which is short to the seventh or eighth, and then *decrease* to the last, on which the cartilage is seldom more than half an inch in length ; the *superior* seven are broad and flat, and resemble much the shape of the ribs, the *inferior* are rounded, and diminish in size *anteriorly* where they become more or less

pointed,—the *direction* of the cartilages is different, the first descends, the second runs transversely, the remainder ascend with an obliquity increasing as far as the tenth rib, the eleventh and twelfth cartilages *descend* in the direction of the corresponding ribs, the anterior surfaces of the costal cartilages are convex and covered by numerous muscles; the posterior are concave and correspond superiorly to the *pleura*, the *triangularis sterni* muscle and the *vertebral artery* and *inferiorly* to the *transversalis abdominis* muscle, and the *diaphragm*, their *superior* edge is concave, the *inferior* convex, they give attachment to the inner layer of the intercostal muscles with the exception of the upper edge of the first, and the lower edge of the last; the two *extremities* are convex, the *external* one is received into a depression in the anterior extremity of the rib, to which it is immoveably connected; the *internal* is attached, in the true ribs, to the concave surfaces already described on the edges of the sternum, where a ball and socket joint is formed, lined by synovial membrane, and possessing considerable motion in the young subject; the three *superior false* ribs are continuous with one another, and with the cartilage of the last true rib, and occasionally present on their edges, (when they are in contact with each other,) small articulating surfaces; those of the floating ribs are separated from the rest, and are lost in the abdominal muscles. The cartilage of the *first rib* is exceedingly *short*, and is remarkable for being more intimately connected to the sternum than the rest, and for being continuous with the *inter-articular cartilage* of the *sterno-clavicular articulation*; the *second* is remarkable for being identified at its

anterior extremity with the cartilaginous structure already described as connecting the two pieces of the *sternum*, with each of which it is articulated. To the lower extremity of the sternum is attached the *ensiform or xiphoid cartilage*, it is exceedingly irregular in shape, size, and direction; its *anterior surface* is covered by an aponeurosis derived from the abdominal muscles, its *posterior* gives origin to the triangularis sterni muscle, *inferiorly* the recti, oblique muscles, are attached to it, *superiorly* it is closely connected with the sternum, *laterally* the costo-xiphoid ligaments arise from it and connect it to the seventh rib. The *cartilages* of the ribs are frequently ossified, not only in the old subject, but even in the young, particularly in the phthisical individual, their structure then resembles that of the ribs.

THE LIGAMENTS AND ARTICULATIONS OF THE THORAX.

The *heads of the ribs*, presenting two convex articulating surfaces, are received into and between the articulating surfaces on the bodies of *two* of the *dorsal vertebræ*, and are connected to them by the *anterior costo-vertebral* or *stellated ligament* and the *inter-articular ligament* and a *double synovial membrane*. The *tubercles* are *directly* connected to the *transverse process* of the inferior of the two vertebræ with which the head of each rib is articulated, by the *posterior*, and the *middle costo-transverse ligaments*, and a *capsular ligament* lined by synovial membrane, and *indirectly* by the *inferior costo-transverse ligament*. The *anterior costo-vertebral* or *stellated ligament* is situated in the *interior* of the

thorax, it arises from the *anterior surface* of the *head of the rib* from which it radiates to be attached to the *bodies* of the *vertebræ* above and below, and to the *intervertebral substance* in the centre; the *anterior surface* of this ligament is covered by the pleura and has resting on it the thoracic ganglia of the sympathetic, and on the *right side* the *vena azygos*, on the *left side* the descending *aorta*; its *posterior surface* corresponds to the articulation. The *inter-articular ligament* is situated in the interior of the joint and stretches from the ridge, already described in the head of the rib, to the *intervertebral cartilage* with which it is continuous; it separates the synovial membrane of this articulation into two distinct sacs. The *posterior costo-transverse ligament* arises from the extremity of the *transverse process* of the *vertebra*, passes almost transversely outwards to be inserted into the *non-articular portion* of the *tubercle* of the rib; it is a short and strong ligament. The *inferior costo-transverse ligament* arises, narrow and pointed from the inferior edge of the *transverse process* of the *vertebra above*, descends *obliquely inwards, expands*, and is *inserted* into the upper edge of the neck of the rib *below*, near its connection with the *body* of the *vertebra*: this ligament forms the external boundary of a triangular space through which the posterior branches of the intercostal artery and nerve pass: the triangle is completed *internally* by the body of the *vertebra*, and *superiorly* by the *transverse process* which forms its base: it is called *inferior costo-transverse* from its being attached to the *inferior rib*. The *middle costo-transverse ligament* is composed of a few irregular fibres connecting the *anterior surface* of the *transverse process* to the rib, and is seen by forcibly separating the bones.

The *capsular ligament* surrounds the articulation, and is lined by a synovial membrane, it is a complete ball and socket joint, the convexity on the rib, the concavity on the transverse process; it belongs to the class Arthrosis, and enjoys considerable motion, on which account it contains much synovial fluid. The first rib wants the *interarticular* and the *inferior costo-transverse ligaments*. The eleventh and twelfth ribs want the *interarticular ligament*. The twelfth is unprovided with the *inferior costo-transverse ligament* and has attached to its inferior edge the *false ligamentum arcuatum*, to be described with the diaphragm. The *anterior extremities* of the ribs are connected to the costal cartilages by means of a *synchondrosis* articulation and by the tendinous expansions, derived from the different muscles in the neighbourhood which also serve to connect the *cartilages of the ribs* with the *sternum*; these, in addition, possess a synovial membrane and enjoy a good deal of motion, they form an arthrodial articulation. The last true rib is connected to the xiphoid cartilage by the *costo-xiphoid ligament*. The *structure of the ribs* is compact externally, *spongy* internally, that of the *sternum* principally *spongy* with a thin layer of compact tissue externally. The *structure* of the cartilages resembles that of cartilage in other situations, they possess great elasticity: they are frequently ossified in the old subject. All the bony structures are exceedingly liable to caries.

THE THORAX, thus formed by these different structures, and in the recent state, completed by the intercostal muscles filling the intercostal spaces, is a large conical cavity, giving lodgement to the lungs, heart, etc., situated in the *centre of organic life*, though above the centre of the whole body, and

capable of alternate *increase* and *decrease* for the expansion and diminution of the capacity of the lungs; and, at the same time, possesses sufficient resistance to preserve the contained organs from sudden pressure, so likely to interfere with their functions; in its description we must consider its *apex* and *base*, its *anterior*, *posterior* and two *lateral surfaces*, both externally and internally, its measurements, etc., and the changes produced on all these, during respiration. The *apex* or *summit* of the thorax is truncated, of an oval shape, its longest axis directed *transversely*, it slopes downwards and forwards, it is formed by the first dorsal vertebra *posteriorly*, the *first rib* with its cartilage on either side, and the *sternum*, and *sterno clavicular articulation* anteriorly; through it pass numerous important structures, the *trachea*, *oesophagus*, and *thyroid veins* on the *mesial line*, the *par-vagus*, *sympathetic*, the *right recurrent* and *phrenic nerves*, together with the *right and left venæ innominatæ*, and *superior intercostal arteries*, *laterally*, descend through it to their several destinations, whilst the *sterno hyoid* and *thyroid muscles*, the *arteria innominata*, the *left carotid* and *subclavian arteries*, the *first dorsal nerve*, the *right and left recurrent branches*, and, on the left side, the *thoracic duct* ascend through it into the neck; owing to the numerous parts passing through it, the resisting structures entering into its formation, and its small size, it varies little during respiration; the only alteration produced in it, is during *inspiration*, when it becomes a little enlarged in the antero-posterior direction. The *base* of the thorax is situated *inferiorly*, and is formed by the *last rib*, the *cartilages of all the false, and the last true ribs*, the *ensiform cartilage*, the *spinal*

column, and the *diaphragm*, it is contrasted with the superior in being of considerable size, in the mobility of the structures which form it, and in undergoing great enlargement and contraction during respiration; its *circumference* is irregular, presenting anteriorly a prominence formed by the xiphoid cartilage, then a superficial notch between this and the extremities of the false ribs, then a convexity formed by the edges of the ribs, and lastly, a deep excavation *posteriorly* formed between the last rib and the side of the spinal column. The *axes* of the apex and base do not correspond, that of the former is directed *downwards* and *backwards*, that of the latter, *downwards* and *forwards*, so that a line drawn through the centre of the base perpendicularly upwards, will pass superiorly, not through the upper aperture or apex, but through the first bone of the sternum. The *anterior surface* of the thorax is directed downwards and forwards, owing to the obliquity of the *sternum*, which is thus separated farther from the vertebral column *inferiorly* than *superiorly*; it is nearly plane, but is a little depressed in its centre, and slightly convex externally where it is formed by the junction of the costal cartilages with the ribs; the *posterior surface* also flattened, is formed by the spinous processes of the vertebræ in the centre, and extends laterally to the angles of the ribs, where it projects most in the well formed adult. The *lateral surface* of the thorax is convex, and is covered by numerous muscles, the *pectorals*, *serrati magni*, *obliqui externi*, &c.; its *internal surface* is concave, and lined by the pleura, except *posteriorly*, at the bodies of the vertebræ, and *anteriorly* at the *posterior surface* of the sternum, where the two *mediastina*

are formed ; it presents its *greatest concavity* between the *vertebræ* and the *angles* of the ribs, for the purpose of giving more complete lodgement to the lungs. The *measurements* of the thorax, are the *vertical*, the *transverse* and the *antero-posterior*. The *vertical measurement*, is that from the *apex* to the *base*, it varies in extent, owing to the convexity of the diaphragm ; its greatest extent is *posteriorly*, from the first to the last rib, where a deep excavation is formed between this rib and the attachment of the diaphragm, to receive the inferior edge of the lungs ; its *least* is nearly *in the centre*, owing to the great convexity of the diaphragm in this situation. The *transverse measurement* is that from side to side, and is greatest a little below the centre of the thorax ; the *antero-posterior*, is that from the anterior to the posterior surface of the thorax ; this is greatest opposite to the inferior extremity of the sternum, and a little to one side of the mesial line, owing to the projection of the *vertebræ* posteriorly, and to the deep excavation already described between these and the angles of the ribs. All these measurements are capable of great *increase* in *inspiration*, during which act, the *diaphragm* descends, the *ribs* are elevated, the *sternum* thrown forwards, and the *costal cartilages* twisted ; that which undergoes the greatest alteration is the vertical, this is effected by the descent of the *diaphragm* towards the abdomen, and by the elevation of the ribs widening the intercostal spaces ; the *transverse measurement* is increased by the elevation of the ribs, in which, from their twisted shape, they are still farther separated from the vertebral column ; the *antero-posterior measurement* is *enlarged* by the inferior extremity of the sternum

being thrown forwards when the ribs are elevated; the chief agents in raising the ribs are the intercostal muscles, the pectorales major and minor, the serrati magni; *inforced inspiration*, other muscles may be brought into operation, such as the scalenus anticus, the sterno-mastoid, the serratus posticus, superior, and inferior. In *expiration*, the thorax returns to its original state by the *relaxation of these muscles*, by the *triangularis sterni* drawing down the *sternum*, by the *abdominal muscles*, attached to its inferior circumference, depressing the ribs, and forcing the abdominal viscera upwards against the diaphragm, and by the resiliency of the costal cartilages; like *inspiration*, it may be, or carried to a much greater extent than natural, by the increased action of these muscles aided by the latissimus dorsi, serratus inferior posticus, etc.

The *thorax* in the *female* is *shorter* than in the male, we consider it also to be more *circular*, and not to present those flat surfaces anteriorly and posteriorly; it frequently in this sex is of a *barrel* shape, that is, expanded in the centre, and contracted inferiorly, this shape is in general produced by the use of artificial pressure. In the *old subject* the thorax possesses comparatively but little motion in consequence of the ossification of the costal cartilages, hence respiration at this period is principally performed by the diaphragm. In the *fœtus* the thorax is far advanced in development, as it is called into action as soon as the child is born; it is much more expanded *inferiorly* to accommodate the large size of the abdominal viscera, particularly the liver; its *antero-posterior diameter* is proportionally greater to afford space for the *thymus gland* and the *heart* situated on the mesial line. This is caused by the ribs running almost

directly forwards, owing to their angles not being developed ; for this reason also the posterior fossæ in the interior of the thorax hardly exist, and its most *prominent part posteriorly* is formed by the vertebræ. The ribs have three points of ossification, one for the head, a second for the tubercle, and the third for the body. The sternum as already mentioned has five.

SECTION III.

THE PELVIS.

The PELVIS is a large bony cavity, situated at the *inferior* part of the trunk, supporting the spine, etc., *superiorly*, resting *inferiorly* on the lower extremities, and containing the pelvic viscera ; it is formed by four bones, the *sacrum*, two *ossa innominata*, and the *os coccygis*.

The *sacrum* is situated at the *posterior* part of the pelvis, between the spine *above*, the *os coccygis* below, and the *ossa innominata* on *either side* ; it is of a triangular or wedge shape, the base directed *upwards*, the apex downwards, for the purpose of being the more firmly impacted between the *ossa innominata* by weight of the trunk from above ; it presents for examination, a *base* an *apex*, an *anterior* and *posterior*, surface, and two *lateral edges*.

The *base* of the *sacrum* is turned *upwards* and slightly *forwards*, and presents its greatest extent in the transverse direction ; in its centre is an oval articulating surface cut off obliquely to receive the intervertebral

substance connecting it to the last lumbar vertebra, it projects *anteriorly* where it forms with this vertebra the *promontory* of the *sacrum* so well known to accoucheurs ; *behind* this is the upper aperture of the *sacral canal* of a triangular shape, giving lodgement to the termination of the *cauda equina*, and continuous *superiorly* with the *spinal canal*, it is bounded laterally by two articular processes, concave, directed *backwards* and *inwards*, to unite with the *inferior articular processes* of the last lumbar vertebra ; *laterally* the base of the sacrum is excavated and is covered by an expansion from the sacro-iliac and ilio-lumbar ligaments : the *apex* of the sacrum is turned downwards and curves slightly forwards, it possesses a transversely oval surface for articulating with the os coccygis ; the *anterior surface* of the sacrum looks also *downwards*, it is smooth and concave and presents in the centre four or five *transverse ridges*, indicating the size of the different pieces (termed *false vertebræ*) of which the sacrum is composed in infancy ; on *each side* of these are the *anterior sacral foramina* for transmitting the anterior sacral nerves, four or five in number, much larger than the posterior, and diminishing in size from above downwards ; they are separated by bony surfaces which give attachment to the pyriformis muscle : the *posterior surface* of the sacrum is turned considerably upwards, it is convex and irregular ; we observe on it in the mesial line, three, four, or five eminences more or less united, which correspond to the spinous processes of the *vertebræ* ; *at their inferior extremity* is a triangular aperture in which the spinal canal terminates, bounded laterally by two tubercles, which give attachment to the sacro-sciatic ligaments, beneath them is a groove which forms with the os coccygis a

foramen for the transmission of the last sacral nerve ; on *each side* of the spinal eminences is a groove continuous with the vertebral gutters above, and perforated by the four or five *posterior sacral foramina* for transmitting the *posterior sacral nerves* much smaller than the anterior, and diminishing in size from *above downwards*—*externally* to these are rough lines, analogous to transverse processes, for the attachment of ligaments ; the *lateral edges* of the sacrum are wide above, narrow and thin inferiorly ; they are marked *superiorly* by a rough articular surface, resembling somewhat the *human ear* with the concavity turned backwards, for connection with the os innominatum, *beneath* this it gives attachment to the *sacro-sciatic ligaments*, and forms part of the *great sciatic notch*. The *sacrum* belongs to the class of irregular bones, and is composed almost altogether of *spongy* structure.

The *os coccygis* or, as it should be called, the *ossa coccygis* is an assemblage of three, four or five irregular small bones decreasing in size from *above downwards*, and held together by ligaments ; they are connected *superiorly* to the extremity of the sacrum with which they articulate, and present here a notch to form a foramen with the sacrum for the exit of the last sacral nerve ; *posteriorly and laterally* they are rough and give attachment to the *sacro-sciatic ligaments* and the *coccygeus* muscle ; *anteriorly* they are smooth and concave, *inferiorly* they are pointed and give attachment to the *ano-coccygeal ligament* ; the bones of which it is formed are consolidated at an early period of life, not only together, but with the sacrum, particularly in the male subject, occurring in him at the age of thirty-five or forty, but in the female not till forty-five or fifty ; their class, etc., are as the sacrum.

The *ossa innominata* are two irregularly shaped bones situated one on each side of the pelvis, forming its *lateral* and *anterior boundaries*, each consists of three bones, the ilium, ischium, and pubis, firmly united in the adult, but separated in the young subject, these three bones unite together in the *acetabulum*, besides this the *ilium* unites with the *pubis* at the *ileo-pectineal eminence*, with the *ischium* at the sciatic notch a little *above* its spinous process; the ischium unites here with the ilium and with the pubis at the junction of their rami anteriorly; the pubis unites with the ilium and ischium at the points mentioned: of these the ilium is the largest, and forms the superior expanded part of the os innominatum; the ischium is next in size, and forms the posterior inferior part, whilst the pubis is the smallest, and occupies the anterior part of the bone. The *os innominatum* is somewhat of an hour-glass shape, contracted in its centre at the upper edge of the acetabulum, expanded at its extremities; it is very much twisted on itself, so as to present an *external surface* irregularly convex, an *internal* concave: in describing this bone, we shall first consider both the surfaces as divided into a *posterior superior*, and an *anterior inferior* portion, and then trace round the *circumference* of the bone; the *external surface* of the os innominatum is divided into the *posterior superior*, and *anterior inferior* portions, by the acetabulum; the *posterior superior* part formed by the os ilium, is the largest of the two, and presents a large quadrilateral surface, concave *posteriorly*, and directed backwards and outwards, convex *anteriorly* looking forwards and outwards; at its *most posterior* part we see a rough triangular surface from which the *glutæus maximus* arises; *more anteriorly*, the bone

presents a rough surface, which commences narrow and pointed at the *anterior superior spinous process* of the ilium, and terminates *posteriorly* at the *posterior inferior spinous process*, where it expands considerably for the origin of the *glutæus medius* muscle; *inferior* to this the bone is smooth and offers a semicircular surface for the origin of the *glutæus minimus* muscle; in it we, in general, see a large foramen for the transmission of a vessel to supply the bone, a little *beneath* and *anterior* to this the bone is rough to give attachment to the tendinous origin of the rectus femoris and the cotyloid ligament, and projects considerably, so as to overhang a large cup-like cavity, termed the *acetabulum*, which receives the head of the femur, and thus contributes to form the hip joint, in the consideration of which, we shall more particularly describe it; here the os innominatum becomes contracted; from this *forwards* it again expands and forms its *anterior inferior portion*, principally composed of the *ischium and pubis*, this is concave, directed *downwards, forwards, and outwards*; in its centre we observe a large foramen of an oval shape, termed the *obturator foramen*, or *foramen ovale*, this is the largest bony foramen in the human skeleton, its *margin* is thin and sharp, and gives attachment to the *obturator ligament* which nearly closes it up; in tracing it towards its superior part, we find it terminates in two extremities an *anterior* or *outer*, and a *posterior* or *inner*, the *anterior* or *outer edge* gets *internal* to the other, and terminates at the tubercle of the pubis; the *posterior* or *inner* extremity passes outwards and backwards, and terminates on the internal surface of the bone; by this contrivance an oblique bony groove is formed for the transmission of the *obturator artery, vein and*

nerve, without any danger of the protrusion of the intestines, round the external circumference of this foramen the *obturator externus* muscle arises; *superior* and *internal* to this is a triangular portion of bone termed the *angle* of the pubis, from which the *adductor longus* and *brevis* muscles superiorly arise, and the *gracilis* inferiorly; immediately below this the bone contracts and forms the descending ramus of the pubis, and gives further origin to the *gracilis*, and part of the *adductor magnus* muscle; *below this* and separated from it by a rough surface which marks the junction of the pubis and ischium is the *ascending ramus* of the ischium from which arises the remainder of the *adductor magnus* muscle, then the *tuberosity of the ischium*, a large bony prominence projecting inferiorly, and affording origin to several muscles; *ascending* from this towards the acetabulum, we meet with a deep groove which gives lodgement to the *obturator externus* tendon. The *internal surface* of the os innominatum is in like manner divided into a *superior* and *inferior* part, by a prominent ridge, termed the *linea ileo-pectinea*; the *superior*, called also the *iliac fossa*, is concave, looks *upwards, forwards, and inwards*, and is filled up by the *iliacus internus* muscle; in it we perceive a large nutritious foramen; it is bounded *superiorly* and *anteriorly* by the circumference of the bone, *internally* by the *linea ileo pectinea*, this line or ridge commences *anteriorly* sharp and prominent at the spine or tubercle of the pubis, from this passes backwards and outwards, and then turns slightly inwards, and terminates at the junction of the sacrum and ilium, where it is rounded off; at its *anterior* extremity it gives attachment to Gimbernat's ligament, which occupies nearly an

inch, then to the pectineus muscle and pectineal portion of the fascia lata for about an inch and a half, and then to its termination *posteriorly* to the iliac fascia; beneath this is the *inferior* portion, this is irregularly concave, and looks backwards, upwards, and inwards; in its anterior part we observe the obturator foramen already described, round which arises the obturator internus muscle and the obturator fascia and a few fibres *anteriorly* of the levator ani muscle; posterior to this the bone is smooth and covered by the last mentioned parts; the *circumference* of the os innominatum presents an exceedingly undulating line, commencing *anteriorly*, at the anterior superior spinous process of the ilium, we shall trace it downwards and inwards, and then continue our course along it until we arrive at the part from which we started, we meet then with the following objects:— the *anterior superior spinous process* of the ilium, which gives origin to the sartorius muscle, and Poupart's ligament *anteriorly*, and the tensor vaginæ femoris *externally*, beneath this is a *notch* for the exit of the inguino cutaneous nerve, bounded *inferiorly* by the *anterior inferior spinous process* of the ilium, from which arise the rectus femoris muscle and the accessory ligament of the hip joint, then a deep groove through which glide the tendons of the psoas magnus and iliacus internus muscles; internal to this the *ilio pectineal* or *pubal* eminence into which is inserted the psoas parvus tendon and which marks the junction of the ilium and pubes; internal to this is a long triangular portion of bone, its apex internally, its base externally, slightly excavated, termed the *horizontal ramus* of the pubis from which the pectineus muscle arises, then the spine or *tubercle* of the pubis,

a projecting pointed eminence which serves for the insertion of the outer pillar of the external abdominal ring; next the *crest* of the pubis extending horizontally between this and the symphysis pubis, and affording origin to the recti and pyramidales muscles, and forming the base of the external abdominal ring; descending from this is the *angle* of the pubis, formed between the *crest* and *symphysis pubis*, in front of which passes the internal pillar of the ring; descending vertically is the *symphysis pubis*, where the two ossa innominata are joined by cartilage, then the edge of the descending ramus of the pubis and ascending of the ischium affording attachment to the triangular ligament, the perineal fascia, the crura penis, erector penis muscle, etc.; then the *tuberosity* of the ischium giving attachment to the biceps semitendinosus and semimembranosus muscles inferiorly, the quadratus femoris and superior gemellus posteriorly, together with the great sacro-sciatic ligament, superior and posterior to this is the *lesser sciatic notch*, a smooth depression, prolonged internally, between the tuberosity and spine of the ischium through which passes *out* the tendon of the obturator internus muscle, by which it is sometimes grooved; through it also pass *in* the pudic artery and nerve, above this is the *spine* of the ischium, a sharp bony prominence for the insertion of the lesser sacro-sciatic ligament and the origins of the superior gemellus muscle *externally*, the coccygeus muscle *internally*; next is the great *is-chiatic or sciatic notch* completed posteriorly by the edge of the sacrum, and converted into a foramen by the great sacro-sciatic ligament, subdivided by the lesser, as we shall shortly describe more particularly; through this pass

out the glutæal artery and superior glutæal nerve, the pyriformis muscle, the greater and lesser sciatic nerves, and the sciatic and pudic arteries; the glutæal artery and its accompanying nerve pass out *above* the muscle, the rest *beneath* it; this is bounded posteriorly by the *posterior inferior spinous process* of the ilium, but badly marked, articulated with the sacrum to which it is connected by ligaments and *internally* marked by a rough articulating surface which corresponds to that on the sacrum; above this is the *posterior superior spinous process* of the ilium, giving attachment to the sacro-iliac and ilio-lumbar ligaments; and lastly is the *crest* of the ilium, a projecting lip of bone, twisted so as to resemble an italic *S*, *posteriorly*, thin and concave externally, convex internally; *anteriorly* thick, concave, and convex in opposite directions; it gives attachment by its *outer* edge to the external oblique, latissimus dorsi, and glutæus maximus muscles, by its *internal* to the transversalis and quadratus lumborum and between these edges to the internal oblique muscle; it terminates *anteriorly* at the anterior superior spinous process of the ilium, from which we set out. The ossa innominata belong to the class of flat bones, their *structure* is, therefore, *spongy*, enclosed between two laminæ of compact tissue.

THE LIGAMENTS OF THE PELVIS.

The bones of the PELVIS are connected to one another and to the last lumbar vertebra by powerful ligamentary and cartilaginous structures. The *sacrum* is connected to the last *lumbar vertebra*, by the *intervertebral substance*, the *ligamenta subflava* and the

continuation of the *anterior* and *posterior* common ligaments, etc., precisely as the *vertebræ* are connected together; with the addition of the following ligament.

The *sacro-vertebral* ligament arises on each side from the anterior and inferior surface of the transverse process of the last lumbar vertebra, descends obliquely downwards and outwards, and is inserted into the base of the sacrum where it is continuous with the other ligamentary structures in this situation.

The *os ilium* is connected to the *spinal column* by the *ilio-lumbar* ligament only; it is of a triangular shape and arises narrow, thick, and pointed, from the summit of the transverse process of the last lumbar vertebra; it passes almost horizontally outwards, spreads out so as to leave intervals between its fibres, and is implanted by its base into the posterior superior spinous process of the ilium; it lies between the *psoas magnus* muscle in front, and the lumbar mass of muscles behind, and gives origin by its upper edge to the *quadratus lumborum* muscle. Between the *sacrum* and *ilium* we have an articulation, more frequently called the *sacro-iliac symphysis*, from its possessing little, if any, motion; this articulation is formed by the irregular articulating surfaces already described on the lateral surfaces of the sacrum and ilium, each of which is lined by a thin layer of cartilaginous structure almost united together in the adult, and possessing, in its interior, a remarkable semifluid substance; in the foetus the articulation is lined by a synovial membrane; *anteriorly and posteriorly* it is strengthened by irregular bands of fibres, termed, from their situation and attachment, the *anterior* and *posterior sacro-iliac* ligaments; they are exceedingly strong, and are attached *internally* to the sacrum, and *externally* to

the posterior inferior spinous process of the ilium, spreading out to be continuous with the periosteum and the other ligaments of this part.

The *sacrum* is connected to the *ischium* by the *greater* and *lesser sacro-sciatic ligaments*.

The *greater sacro-sciatic* ligament arises from the lateral and posterior surfaces of the sacrum, and also from the posterior inferior spinous process of the ilium and edge of the os coccygis; it passes *downwards, forwards, and outwards*, and is implanted into the tuberosity of the ischium, whence it sends a prolongation forwards to be continuous *externally* with the origins of the hamstring muscles, *internally* with the obturator fascia, and is prolonged *anteriorly* into a process which assists in binding down the internal pudic artery; this ligament is somewhat of an hour-glass shape, narrow and thick in its centre, broad and thin at its extremities, its *outer* surface is rough, perforated by vessels, and gives origin to the glutæus maximus muscle, *internally* it is for a short extent, *posteriorly*, connected to the lesser sacro-sciatic ligament, and forms the *posterior lateral* boundary of the perinæum; it is situated external and posterior to the lesser.

The *lesser sacro-sciatic ligament*, arises *internal* and *anterior* to the greater, from the edge and anterior surface of the sacrum, and edge of the os coccygis, where it is broad and expanded; runs horizontally *forwards* and *outwards*, and terminates in a point which is implanted into the spinous process of the ischium; its *outer* surface is covered *posteriorly* by the great sacro-sciatic ligament, anteriorly is encircled by the pudic vessels and nerves, internally it corresponds to the coccygeus muscle. The *great sacro-sciatic ligament*

converts the sciatic *notch* into a large *foramen*, which is divided into a greater and lesser, by the *lesser sacro-sciatic ligament*; the *latter* of these gives egress to the tendon of the obturator internus muscle, ingress to the pudic vessels and nerves; the former gives exit to the pyriformis muscle, the gluteal artery, and superior gluteal nerve, the greater and lesser sciatic nerves, the sciatic and pudic arteries; the first two pass out above the muscle, the remainder below it. These ligaments, besides connecting the bones together, serve the important office of closing up the inferior aperture of the pelvis, and thus assist in supporting the weight of the pelvic viscera. The *ossa innominata*, are united anteriorly where the ossa pubis enter into their formation by a fibro-cartilaginous structure, termed the symphysis pubis; this more properly consists of two portions, one of which belongs to each os pubis; they are of an oval shape, directed downwards and backwards, thin *posteriorly*, thick *anteriorly*; they are dense and elastic, and are composed of fibres, taking different directions, some transverse, other concentric; in some subjects, particularly in the female, a *synovial membrane* has been described as existing between these cartilages near their *posterior* surface, it is said to be lubricated with a little fluid, and to allow of slight motion; this, however, is very doubtful; its great use is, besides connecting the bones, to form an elastic basis, with the cartilages at the sacro-iliac articulations, on which the extremities of the ossa innominata may rest, that shocks may be with greater difficulty transmitted to the spinal column; this articulation is strengthened in front and behind by fibrous structures, termed its anterior and posterior

ligaments; they are not important; the ossa innominata, are further connected by the *sub-pubic ligament*, the *triangular ligament* of the urethra, etc., those parts will be more properly described, when considering the genito-urinary organs. The *obturator foramen*, is nearly closed up by the *obturator ligament*; it is an exceedingly thin, delicate ligament, deficient *superiorly*, to allow of the passage of the obturator vessels and nerves; it is covered *internally* and *externally* by the obturator internus and externus muscles respectively.

The PELVIS thus formed is divided into the *false* and *true* by the *linea ilio-pectinea*; the expanded portion *above* that line is the *false* pelvis; it is concave, and lodges the iliacus internus and psoæ muscles, branches of the lumbar plexus of nerves, and the external iliac artery and vein, together with the cœcum and vermiform appendix on the *right* side, the sigmoid flexure of the colon on the *left*; the deep contracted portion below this line is the *true* pelvis, it contains the bladder and rectum, the small intestines, the internal iliac arteries and veins, and their branches, the sacral and sympathetic nerves, the ureters, etc. in both sexes, and, in addition, the prostate gland, vesiculæ seminales and vasa deferentia in the male, the uterus with its appendages and vagina, in the female. In describing the pelvis, we must consider its *superior* and *inferior* apertures or straits, and its different measurements, consisting of the *transverse*, the *antero-posterior*, the *oblique* and the *vertical*. The *superior* aperture of the *false* pelvis is of an oval shape, the longest diameter directed transversely; it is bounded *posteriorly* by the sacrum, by the crest of the ilium *on each side*, and *anteriorly* by the two ossa pubis, united at

the symphysis, which thus form its circumference exceedingly undulating ; elevated *laterally*, depressed *posteriorly*, and still more so *anteriorly*, as the crest of the pubis anteriorly reaches on a level with about the third bone of the sacrum posteriorly, a line drawn through its centre would run *downwards* and *backwards*, its aspect is *upwards* and *forwards*. The *superior* aperture of the *true* pelvis is much smaller than that of the *false*, it is *triangular* in the male, its base posteriorly, *oval* in the female with its long axis directed transversely ; it is bounded *posteriorly* by the sacrum, *laterally* by the linea innominata, or ilio-pectinea, *anteriorly* by the pubis ; it is directed downwards, and more backwards than the superior ; its aspect is upwards and forwards, a line prolonged downwards through its centre, will touch the lower third of the sacrum. The *inferior* aperture of the pelvis is of a diamond shape, long from before backwards, expanded in its centre between the tuberosities of the ischia : pointed posteriorly at the extremity of the os coccygis, and anteriorly at the sub-pubic angle ; formed by the meeting of the os pubis of each side ; it is bounded *posteriorly*, by the os coccygis ; *laterally* by the sacro sciatic ligaments posteriorly, the tuberosities of the ischia in the centre, and the rami of the ischium and pubis in front, and *anteriorly* by the sub pubic ligament filling up the angle of the pubis ; it contains the perinæum ; its axis is downwards and a little backwards ; a line drawn upwards through its centre, will touch the sacro-vertebral angle, it is closed by several ligamentous and other structures, to prevent the pelvic viscera from descending through it.

The Student may have perceived that the axes of

the three apertures of the pelvis do not correspond, that, on the contrary, the axes of the upper apertures, if prolonged towards one another, would meet so as to form an angle salient *anteriorly*, and that the axes of the upper and lower apertures of the *true* pelvis, would meet in the centre of the pelvis, so as to form nearly a right angle, projecting *posteriorly*; this is a wise provision of nature, to prevent the abdominal viscera from being forced downwards towards the perinæum; by this contrivance they are rather directed against the ossa pubis in front.

The *transverse* measurements of the pelvis are three in number, two *superior*, and one *inferior*; the two superior are those of the superior apertures of both false and true pelvis, the former measuring from the anterior superior spinous process of the ilium on one side to that of the other; the latter, the greatest distance between the two lineæ ilio-pectineæ, the *inferior* is that of the lower aperture of the pelvis and includes the space between the two tuberosities of the ischia; the *antero-posterior* is that from the upper border of the symphysis pubis backwards and upwards to the promontory of the sacrum. The *oblique* measurement is from the ilio-pectineal eminence of one side, to the sacro-iliac symphysis of the other. The *vertical* measurements are the *lateral* from the ilio-pectineal line to the tuber ischii, and the *anterior* measuring the depth of the symphysis pubis; to these we may add the sub-pubic angle—all these measurements differ in the female from the male, being, generally speaking, much larger in the former, for the obvious purpose of containing the impregnated uterus and giving exit to its contents; they are computed in the following table:—

	In the male.		In the female.	
	Inches.	Lines.		
The transverse measurement of the false pelvis.....	9		10 to 10	6
The transverse measurement of the true pelvis.....	4	6	5	5 6
The transverse measurement of the inferior aperture	3	2	4	
The antero-posterior measurement of the true pelvis.....	4	5	4	8
The oblique.....	4	0	4 6	5 0
The vertical lateral measurement..	4	10	3	6
The vertical anterior.....	1	10	1	6
The subpubic angle.....	40° to 80°		90°	
The antero posterior measurement of inferior aperture varies, particularly in the female, on account of the great mobility of the os coccygis.....	3	6	4	4 10

Besides these differences in the measurements of the pelvis in the male and female subjects it differs in other circumstances; in the *female* the sacrum is broader, but shorter, it is said to be more curved or concave forwards, the ossa coccygis are more moveable and are not consolidated till an advanced period of life; the ossa ilii are expanded considerably outwards, so that the pelvis is the widest part of the female trunk; the inferior aperture is much larger; owing to the greater interval between the tuberosity of the ischia, the greater mobility of the os coccygis and the extent of the sub-pubic angle, the foramen thyroideum is of a more triangular shape; in fine, the female pelvis is adapted, as far as is possible, to give more perfect and safe lodgement to the distended uterus and a free exit to its contents. In the foetus the pelvis is remarkably small and consists of several bones, the sacrum being then divided into four or five pieces, and the os innominatum into the ischium, ilium and pubes, all of which become consolidated before the age of puberty; they are nearly straight, so that the cavity of the pelvis scarcely exists; and

present epiphyses at the crest of the ilium and the tuberosity of the ischium; the bladder, rectum and small intestines then chiefly occupy the abdominal cavity; its aperture is more directly forwards, the change which takes place in the adult being produced by the gradual development of the anterior part of the pelvis, and from its being forced upwards in front by the ossa femoris and pressed downwards by the spinal column behind. In old persons the pelvis undergoes but little alteration, if we except the change in the ossific deposit which occurs in all bones; its obliquity is lessened by the spine curving forwards and the knee bending so as to preserve the centre of gravity.

The bones of the pelvis are supplied with vessels which enter in different situations, but chiefly in their circumference, where may be seen numerous foramina for their transmission.

CHAP. III.

THE LOWER EXTREMITIES.

The *lower extremities* are two in number, and may be divided each into the *thigh*, *leg*, and *foot*.

SECTION I.

THE BONES OF THE LOWER EXTREMITIES.

The **BONES** of the *lower extremity* consist of the *femur* or *thigh bone*, the *patella*, the *tibia*, and the *fibula*, which are those of the *leg*; together with those of the foot, consisting of the *astragalus*, *os calcis*, *os naviculare*, or *scaphoides*, *os cuboides*, *three ossa*

cuneiformia, five metatarsal bones; and fourteen phalanges constituting the toes.

The *femur* or *thigh bone* is the longest and largest bone in the body, and extends from the *os innominatum* to the *tibia*, it consists, from above downwards, of a *head, neck, trochanters, body* or *shaft* of the bone, and the *condyles*. The *head* of the femur is a round spherical eminence situated at the highest part of the femur, encrusted with cartilage, and enters into the formation of the *hip joint*; near its *centre* but a little *posterior* and *inferior* to it is a depression which affords attachment to the *ligamentum teres*; from the head descends the *neck* of the femur obliquely *downwards*, and *outwards*; this is a triangular portion of bone which supports the head and connects it to the body of the femur, having its apex at the head of the bone, its base towards the shaft, where its extent is limited by two lines, termed the *anterior* and *posterior inter-trochanteric lines*; *posteriorly* it is more extensive than *anteriorly*, and is exceedingly rough and porous for the transmission of vessels; it presents many peculiarities in the different sexes, and in the several periods of life, which with the head of the bone will be more particularly considered in the anatomy of the *hip joint*; as we pass from the *neck* towards the *shaft* of the bone, we meet with *two lines*, one on the *anterior*, the other on the *posterior* surface, stretching obliquely *downwards* and *inwards*, from the greater to the lesser trochanter, these are the *anterior* and *posterior inter-trochanteric lines*; the latter is much the more prominent, and is separated by a greater interval from the head of the bone; the *anterior inter-trochanteric* line affords attachment to the capsular ligament of the hip joint, but the *posterior* does

not, (although frequently asserted) *it* gives insertion to a part of the quadratus femoris muscle ; at either extremity of these lines may be observed two eminences, the one the *superior* and *external*, large, flat, and quadrilateral, is called the *trochanter major* ; the other small, pointed, and triangular, the *trochanter minor* ; the former of these, the *trochanter major*, is placed at the upper extremity of the shaft of the bone, and projects considerably beyond it, is directed upwards but towards its superior part inclines a little *inwards* ; its *external* surface is convex, rough, and irregular, and is covered by the glutæus maximus muscle, from which it is separated by a large bursa mucosa ; at its lower part is a remarkable prominence which gives attachment to a portion of the vastus externus muscle ; its *internal surface* is concave and not near so extensive as the external, it is marked towards its *posterior* and *upper* part by a deep depression, termed the *digital fossa*, into which and the surface immediately below it are implanted the tendons of the pyriformis, superior, and inferior gemellus, and the obturator internus, and externus muscles ; *anteriorly* the trochanter is also rough and gives insertion to the tendon of the glutæus minimus muscle ; its *posterior surface* smoother and more convex has attached to it the quadratus femoris muscle ; *superiorly* the trochanter major is bent inwards and terminates by a rough, narrow surface, into which is implanted the glutæus medius muscle, *inferiorly* the trochanter is lost in the shaft of the bone ; the *trochanter minor* is a prominence situated at the inner and rather posterior part of the femur, immediately beneath the neck, it is directed inwards, and often a little forwards, as if by the action of the muscles ; it

is pointed and triangular, and gives insertion at its *posterior* part to the psoas magnus and iliacus internus muscles, and the accessory ligament of the hip joint, a bursa intervenes between this process and the muscles; from it proceed *three lines*, the *two inter-trochanteric lines* already described, running from it upwards and outwards, the third, descending inwards, terminates in the linea aspera. The *body* or *shaft* of the femur is that part of the bone which extends from the trochanter above, to the condyles below, and connects those parts together; it is directed obliquely downwards and inwards, so that when placed in situ, its inferior extremity approaches that of the opposite side; *superiorly* and *inferiorly* it is somewhat quadrilateral, but in its centre is of a triangular shape; it may be divided into an *anterior*, an *external*, an *internal*, and a *posterior* surface, the *anterior* surface of the femur is convex, is larger above and below than in the centre; it is twisted on itself so that superiorly it is directed a little outwards, but inferiorly directly forwards; it gives attachment in its three superior fourths to the cruræus muscle, in its inferior fourth to small capsular muscle termed the subcruræi, and below these is covered by the synovial membrane of the knee joint; the *external* surface of the femur is larger than any of the others, it is concave above, convex below, and gives attachment to the vastus externus muscle; the *internal* surface is less extensive than the external, and is the reverse of it, that is, is convex above, concave below; it is covered by the vastus internus muscle; there is about an inch in breadth of this surface of the femur extending almost its whole length, from which no muscular fibres arise; the *posterior surface* of the femur is the least extensive,

being exceedingly narrow in the centre, and but a little expanded above and below; it is concave posteriorly, in its centre; on it we perceive running downwards and inwards in the axis of the bone, a rough line, termed the *linea aspera*, much better marked in the middle than at either extremity, and sometimes divided into two by a groove in the centre; superiorly this arises by two lines, an *external* and *internal*; the *external* is strong and well marked, and proceeds from the great trochanter, downwards and inwards; it gives attachment *externally* to the vastus externus muscle, *internally* to the adductor magnus, and in *the centre* to the tendon of the glutæus maximus muscle; the *internal* is indistinct, and proceeds downwards and outwards from the lesser trochanter; it gives attachment to the pectineus, vastus internus, and adductor *brevis* muscles; between these two lines, a triangular interval exists, which is occupied by the origin of the adductor magnus, and the insertion of the quadratus femoris muscle; by their convergence *inferiorly*, the *linea aspera* is formed; this line gives attachment *externally* to the vastus externus muscle, and short head of the biceps; *internally* it affords attachment to the vastus internus, and the three adductors; as we trace the *linea aspera inferiorly*, it terminates as it arises, by two lines, an *external* and *internal*; the external one strong and well marked, passes downwards and outwards, and terminates at the external condyle; it gives attachment to the vastus externus muscle and short head of the biceps; the *internal* passes downwards and inwards, and ends at the inner condyle; it is but badly marked, particularly in its *centre*, where it is rounded off to allow of the femoral artery to wind round the bone

in this situation; it gives attachment to the vastus internus and adductor magnus muscles; from the termination of these lines, or rather from rough surfaces internal to them, arise the two heads of the gastrocnemius externus muscle, they, like the superior lines, circumscribe a triangular space, but larger than the superior one, which forms the anterior boundary of the upper division of the popliteal space, it gives attachment to no muscular fibres, *inferiorly* the femur expands and terminates in the *condyles*; these are two large eminences, one external, the other internal, encrusted in a great part of their extent by cartilage, where they enter into the formation of the knee joint; they are separated *in front* by a depression termed the anterior inter-condyloid fossa, which affords lodgement to the patella in the extended position of the knee joint, and *behind* by a similar depression, but much deeper, termed the posterior inter-condyloid fossa, which gives lodgement to the popliteal artery, and is nearly filled up by the ligamentum posticum of Winslow; on the *outer* surface of the external condyle, and near its posterior part is a well marked eminence from which the external lateral ligament of the knee joint arises, and below this a deep depression, from which the poplitæus muscle arises; on its *inner* and rather posterior part, we observe a rough surface which affords origin to the anterior crucial ligament, and insertion to the ligamentum posticum of Winslow; on the *inner* surface of the *internal* condyle, near its posterior part, is a large eminence which gives attachment to the adductor magnus tendon, and to the internal lateral ligament; this projects more than the corresponding eminence on the external condyle; on its *outer*

surface it is rough posteriorly, and gives origin to the posterior crucial ligament ; these two condyles assist in forming the knee joint, and differ in almost every particular ; the internal one is longer from before backwards than the external ; shorter in the transverse direction ; it projects more *posteriorly*, less *anteriorly* ; it is covered more by cartilage *posteriorly*, less *anteriorly*, and descends more *inferiorly* when the femur is placed vertically, and deviates more from the axis of the bone ; on the anterior surface of the condyles, the cartilage ascends so as to form a large articular surface, convex from above downwards, concave from side, to side, for receiving the patella in the extended position of the knee joint ; the two condyles project much more posteriorly, or towards the side of flexion than *anteriorly*, and there present two rounded eminences, for articulating with the tibia in extreme flexion of the knee joint.

The femur is articulated with three bones ; *above* with the os innominatum where it enters into the formation of the hip joint, *below* with the tibia inferiorly, and the patella anteriorly. The femur is supplied with blood-vessels from several sources ; these enter it chiefly at both extremities, where they present numerous foramina for their entrance, in the centre also vessels enter from the periosteum, these are, however, small and indistinct ; in the linea aspera a little above its centre may be seen one or two foramina directed obliquely upwards and forwards, which serve for the transmission of the nutritious or medullary vessels, the veins correspond to and accompany the arteries ; like all bones no nerves can be traced distinctly into it ; its absorbents terminate in the glands of the thigh and pelvis. The structure of the femur is like that

of all long bones, compact in the centre, spongy at either extremity ; the compact tissue is particularly abundant in those situations where most strength is required, *posteriorly*, in the linea aspera which thus gives additional strength to the bone, and *superiorly* towards the inner side of the femur where it supports the neck ; these may be seen by making different sections. The femur possesses five points of ossification, one for the head, one for each trochanter, one for the shaft, and one for both condyles. Let the student now place the bone in situ, that is direct the head upwards, forwards, and inwards, the great trochanter outwards, and a little backwards, and the condyles resting inferiorly on a horizontal plane, the external one projecting anteriorly, he will observe that although the head of the femur appears at first view to be badly placed, so as to support the weight of the body, yet that, from the obliquity of the neck, and then of the shaft of the bone, the weight is transmitted obliquely through these parts nearly to the centre of its inferior extremity ; the arched shape, too, of the femur he may remark, this has been ridiculously ascribed to the hanging of the child on the nurse's arms, to the action of the muscles posteriorly, etc. ; it is to give lodgement to the flexor mass of muscles posteriorly, and to strengthen the bone, as the weight of the body is generally thrown on the femur, when it is brought a little anterior to the vertical line, and thus the utility of the arch becomes manifest ; let him also observe that the femur descends obliquely inwards, in order that the bones may be approximated inferiorly, so as to facilitate progression, were the bones as widely separated

inferiorly as they are superiorly, the gait, although more secure, would be more awkward as may be seen in sailors, etc.

THE BONES OF THE LEG.

The bones of the leg consist of the *patella*, the *tibia*, and *fibula*. The *patella*, or as it is sometimes called, the *rotula*, is a small irregular bone situated at the anterior part of the knee joint between the femur above and the tibia below, of a triangular or heart shape, having its base *above*; its apex *below*, it presents for examination, besides its base and apex, an anterior and a posterior surface, and two lateral edges, the *base* of the patella thick, cut off obliquely upwards and backwards, gives insertion to the tendon of the rectus femoris, and cruræus muscles; its *apex* narrow and pointed, directed downwards, gives attachment to the ligamentum patellæ, the *anterior surface* of the patella, which is in general turned a little outwards, is convex and rough, and is marked by longitudinal lines produced by the fibres of the rectus tendon, in which this bone is developed, and by small foramina for the transmission of vessels, it is covered by a large bursa mucosa, and by a tendinous aponeurosis, derived from the extensor tendons; the *posterior surface* is smooth and encrusted with cartilage, as it enters into the formation of the knee joint, it is divided by a ridge running nearly vertically with a slight degree of obliquity inwards into two unequal portions, an *external* and *internal*; the *external* is large, concave, and corresponds to the articulating surface on the anterior part of the external condyle of the femur, the *internal* is smaller, convex, and is in

contact with the internal condyle, beneath these is a rough triangular surface into which the ligamentum patellæ is implanted, the *lateral* edges are thin, convex, and irregular, and give insertion to the vasti muscles. The *patella*, although generally described as one of the bones of the leg, is rather intermediate between it and the thigh, it is supplied with blood by vessels entering chiefly its *anterior* surface; its *structure* is spongy, covered with a thin layer of compact tissue; it is developed by a single point of ossification which is deposited in the substance of the rectus tendon, from which it derives the appearance of longitudinal fibres remarkable on its anterior surface; it is not completely ossified until many years after birth, and may be considered more properly as a *sesamoid* bone; it articulates only with the femur, being connected to the tibia by ligament; in the *extended* position of the knee joint it rests on the anterior surface of the condyles of the femur, but in the *flexed* position corresponds to the interval between the two bones; its use is to give attachment to the parts enumerated, to obviate the effects of friction in the motions of the knee joint, and to preserve the articulation from injury. To place it *in situ*, its *base* must be turned upwards, its *apex* downwards, its *anterior* surface forwards and outwards, its *posterior* in a contrary direction.

The *Tibia* is the principal bone of the leg, and is situated between the femur *above* and the tarsus *below*, thus forming the only direct bony connexion between the thigh and foot; it is next in size to the femur, and occupies the *inner* and *anterior* part of the leg; it is divided into a *superior* or *femoral extremity*, a *body* or *shaft*, and an *inferior* or *tarsal extremity*.

The *upper* or *femoral extremity* is much larger and more expanded than the *lower*; it is somewhat *oval*, presenting its longest axis in the *transverse* direction; on its upper surface we observe two articulating surfaces, an *external* and an *internal*, termed the *condyles* of the tibia, incrustated with cartilage for articulation with the femur, and separated from one another by a large bony prominence, termed the *spine*, and two rough surfaces, one in front of, the other behind the spine; the *internal articular surface* is of an oval shape, long from before backwards, is concave and more excavated than the external, it corresponds to the internal condyle of the femur; the *external articular surface* is nearly circular, but *slightly* excavated, and slopes downwards and outwards; between these is the *spine*, a large bony eminence, somewhat pyramidal in shape, its apex free and divided into two tubercles, it is directed a little inwards and is placed nearer the *posterior* than the *anterior* part of the tibia; in front of, and behind the spine, are two rough surfaces, the *anterior* one large and irregular gives insertion to the anterior extremities of the semilunar cartilages and to the anterior crucial ligament; the *posterior* small, and excavated posteriorly, affords insertion to the posterior extremities of the semilunar cartilages and the posterior crucial ligament; as we descend from the articulating surfaces of the tibia we meet with *anteriorly*, a triangular somewhat smooth surface, perforated by a number of foramina, covered by a bursa and a quantity of fat, and bounded inferiorly by a large eminence, termed the *tubercle* of the tibia; the lower part of this tubercle is rough, and gives insertion to the *ligamentum patellæ*; the upper

part is smooth, and covered by the bursa before mentioned, which separates it from the ligament; on the *outer side* of the tibia is a projection of the bone marked inferiorly by an articular surface smooth and convex for articulating with the upper extremity of the fibula; *internally* is a projection also, for the insertion of the internal lateral ligament of the knee joint, marked with a groove for the anterior insertion of the semimembranosus muscle, *posteriorly*, a superficial depression filled up by the posterior crucial ligament; the *body*, or *shaft* of the tibia is that part intervening between the upper and lower extremities, it is large and triangular *above*, but becomes smaller and more circular *inferiorly* until we approach the inferior extremity where it again expands; it may be divided into *three surfaces*, an *internal*, *external*, and a *posterior*, separated by *three ridges*, an *anterior*, *external*, and *internal*; the *internal* surface of the tibia, larger above than below, is convex superiorly, a little concave inferiorly; it is directed slightly forwards except inferiorly, where it looks directly inwards; it is covered *superiorly* by the internal lateral ligament of the knee joint, the tendons of the sartorius, gracilis, and semitendinosus muscles, which glide over it here, to be attached to the anterior edge of the tibia, *inferiorly* by the skin and periosteum; the *external surface* is concave in its superior two-thirds for the attachment of the tibialis anticus muscle, convex in its lower third, where the tendons of the tibialis anticus, extensor communis, extensor proprius pollicis, and peronæus tertius muscles glide over it to their insertions; the *posterior* surface is exceedingly irregular, and marked with several ridges for the attachment of muscles, *superiorly* is a rough

line running obliquely downwards, and inwards, into which, and the rough surface immediately above it, the poplitæus muscle is inserted, and from which, the solæus, the tibialis posticus, and the flexor communis muscles arise, immediately below this line the nutritious artery enters the bone; it runs downwards and forwards, and is the largest of those foramina; the surface *below* this line becomes narrow and smooth as it descends, and gives origin to the tibialis posticus, and flexor communis muscles; the *anterior* edge, or spine of the tibia, in common language, the *shin*, is sharp and projecting in the centre, but is lost above and below; it presents an undulating line corresponding to the curves of the tibia, and is perfectly subcutaneous; it gives attachment to the anterior portion of the fascia of the leg, the *external* commences gradually above, turns downwards and backwards, becoming more prominent, and terminating inferiorly by dividing into two, which leave between them a superficial excavation for the reception of the fibula, it gives attachment to the interosseous ligament; the *inner* edge of the tibia only exists at the lower half of the bone, where it gives attachment to the solæus and flexor communis muscles; the *inferior* or *tarsal* extremity of the tibia again expands, and assumes a quadrilateral shape, *anteriorly* it presents a convex extensive surface, into which the anterior ligament of the ankle joint and anterior tibio-fibular ligament are attached, and over which glide the tendons of the anterior muscles of the leg; *posteriorly* a rough surface which gives attachment to the posterior ligament of the ankle joint, and the posterior tibio-fibular ligament, and is marked towards its inner edge by a superficial groove running

downwards and inwards, which gives lodgement to the tendon of the flexor longus pollicis muscle; *externally* is a rough triangular surface concave, which gives lodgement to the fibula, and attachment to ligaments, which connect these bones together; *internally* the tibia descends farther than in any other direction, and presents a thick, and slightly convex quadrilateral projection, termed the *internal malleolus*; this eminence is situated on a plane anterior to the body, or shaft of the bone; *internally* it is rough, convex, and covered only by the integuments; *externally* it is marked by an articulating surface of a pyriform shape, to correspond to a similar surface on the astragalus, for the formation of the ankle joint; it is continuous with the articulating surface of the lower part of the tibia, which it joins at a right angle; *anteriorly* it is rough, and gives attachment to ligaments; *posteriorly* it is grooved for the transmission of the tibialis posticus and flexor communis tendons; *inferiorly* it tapers a little, descends lower in front than behind, and gives attachment to the internal lateral ligament of the ankle joint; *inferiorly* the lower extremity of the tibia presents a surface covered by cartilage for articulation with the upper surface of the astragalus; it is somewhat quadrilateral, concave from before backwards, convex transversely, owing to a ridge which traverses it in the antero-posterior direction, it is wider anteriorly than posteriorly, and broader *externally* than *internally*; it is bounded *externally* by the articulating surface for the fibula; *internally* by the internal malleolus, anteriorly and posteriorly by the projecting edges of the tibia.

The tibia articulates with three bones; the femur

above, the fibula above and below, and the astragalus inferiorly; its structure is like that of the femur, except that its extremities are rather more spongy; its medullary canal is well marked; it is supplied with blood-vessels, nerves, etc., from the neighbouring trunks, which enter as in the femur. This bone is developed by three points of ossification, one for the body, and one for each extremity; the tubercle is occasionally distinct from the rest of the bone, but soon becomes consolidated with it, as is also sometimes the internal malleolus. The tibia, when placed in situ, is directed vertically downwards, thus forming *superiorly* an angle with the femur prominent internally; the tubercle is directed forwards, and the internal malleolus is more anterior than the rest of the inferior extremity of the bone.

The *Fibula* is much smaller than the tibia, but is nearly of equal length; it is situated at the outer part of the leg, and extends, inclining downwards and forwards, from the posterior articulating surface on the tibia *superiorly*, to the astragalus *inferiorly*; it is divided into a *superior* or *tibial* extremity, a *neck*, a *body*, and an *inferior* or *tarsal* extremity; the *superior extremity*, called also the *head* of the fibula, is round and irregular, and presents on its *inner* surface a smooth cartilaginous surface, concave, and directed slightly forwards and upwards for articulation with the tibia; from its external and posterior part ascends a long pointed process, which, with the adjoining surfaces of the bone rough and irregular, gives attachment to the ligaments connecting the fibula and tibia together, to the external lateral ligament of the knee joint, and the tendon of the biceps flexor cruris; it is sometimes grooved *posteriorly* for

the tendon of the poplitæus muscle, the *neck* of the fibula is that part immediately below the head; it is smooth and round externally where the peronæal nerve winds round it; the *body* or *shaft* of the bone is triangular, especially in its *centre*; it descends obliquely forwards and inwards, so that its lower extremity is on a plane *anterior* and *internal* to the upper, is twisted like all long bones, and curves a little *outwards*; it may be divided into three surfaces, an *external*, *internal* and *posterior*, separated by *three ridges*, the *external* surface of the bone directed a little forwards *superiorly*, rather backwards *inferiorly*, is irregularly concave, and gives origin *above* to the peronæus longus, *below* to the peronæus brevis muscle; the *internal surface*, directed a little backwards *superiorly*, and forwards *inferiorly*, is divided by a vertical ridge into two portions, an *anterior* smaller gives origin to the extensor proprius pollicis, the extensor communis, and the peronæus tertius muscles; whilst the posterior larger gives origin to the tibialis posticus muscle; the *posterior surface* irregularly convex, directed outwards *superiorly*, inwards *inferiorly*, gives origin to the solæus muscle *above*, the flexor longus pollicis *below*; it is in this surface of the bone near its *centre*, that we perceive the nutritious artery to enter obliquely downwards, forwards, and inwards—of the three ridges of the fibula, one is *anterior*, another *external*, and a third *internal*; they participate in the curves of the fibula, and are twisted as they descend; the *anterior*, sharp and projecting gives origin to the extensor communis, and peronæus tertius muscles internally, and bifurcates *below*, leaving a concave triangular interval directed forwards and outwards, which is

covered by the integuments ; the *external*, the least prominent of the three, sharp *above* and *below*, rounded off in the *centre*, curved, gives attachment *posteriorly* to the solæus and flexor propius pollicis muscles, *anteriorly* to the peronæus longus and brevis ; the *internal* ridge sharp, occupies only the *superior two thirds* of the bone ; *above* it gives origin to the tibialis posticus and flexor longus pollicis muscles ; below the interosseous membrane is attached to it ; these ridges also afford insertion to the prolongations of the fascia of the leg ; the *inferior* or *tarsal* extremity of the fibula is large and more prominent than the superior ; it forms a large irregular projection, termed the *external malleolus* ; this of a triangular shape ; its *outer surface* is rough, convex, and subcutaneous, the *internal* also convex, but smoother, presents *superiorly* a triangular surface for connection with the tibia, *inferiorly* a smooth articulating surface, a little concave from before backwards, to articulate with the outer surface of the astragalus, and *behind* this, a rough surface into which the posterior, fibulo-tarsal and posterior tibio-fibular or transverse ligament, are implanted ; *anteriorly* the external malleolus is rough and projecting, and gives origin to ligaments connecting it to the tibia *above*, the tarsus *beneath* ; *posteriorly* it is grooved obliquely downwards and outwards for the passage of the tendons of the peronæus longus and brevis muscles ; the apex of the external malleolus is turned downwards, and is placed rather *posteriorly*, the *external lateral ligaments* of the ankle joint are attached near, but not into it. The fibula articulates with two bones, the tibia and the astragalus ; its supply of vessels, structure, etc., are similar to those of the

femur and tibia; it has three points of ossification, one for the shaft and one for each extremity. To place the fibula in situ, the articulating surface on its upper extremity should look upwards, forwards, and inwards; its body should descend forwards and inwards, so that the *external malleolus* will be *anterior* to the rest of the bone, but posterior to the *internal malleolus*; the groove on its lower extremity should be turned posteriorly.

The *Foot* is divided into the *tarsus*, *metatarsus* and *phalanges*.

The *Tarsus* occupies the *posterior* half of the foot; it is narrow and pointed *posteriorly*, wide and expanded *anteriorly*, and is composed of seven bones. The *Astragalus* and *Os Calcis* behind; the *Navicular*, three *cuneiform*, (*internal*, *middle* and *external*,) and the *cuboid* in front. The *Tarsus* may thus be divided like the *carpus* into a *posterior* and an *anterior* row of bones.

The *Astragalus* is the second largest bone of the *tarsus*, being next in size to the *os calcis*, it is situated in the *superior* and *internal* part of the *tarsus*, and nearly in its centre, between the *tibia* above, the *malleoli* on either side, the *os calcis* inferiorly and posteriorly, and the *navicular* bone anteriorly; it is exceedingly irregular in shape; large posteriorly, then contracting, and finally expanding again; it is divided into the *body*, *neck*, and *head*—the *body* of the *astragalus* occupies the *posterior* part of the bone; *superiorly* it presents a smooth cartilaginous surface, quadrilateral, concave from side to side, convex from before backwards, narrower *posteriorly* than *anteriorly*, sloping downwards and inwards; its *outer* edge higher than its *inner* for articulation

with the tibia; on each side of this an articulating surface; one *internal*, somewhat pyriform, with its larger extremity *forwards* for the internal malleolus; the other *external*, triangular with its base above, larger than the *internal*, concave from above downwards, convex from before backwards for the external malleolus; beneath the internal articulating surface the bone is rough for the attachment of ligaments—*inferiorly* the astragalus presents two articulating surfaces; a *posterior* one, large, external, concave, running obliquely backwards and *inwards*, which rests on the body of the os calcis *inferiorly*; an *anterior* one internal, irregular, convex and much smaller, resting on the sustentaculum of the same bone: these two articular surfaces are separated by a *deep groove* running forwards and outwards, wide anteriorly, rough, and marked with foramina for the transmission of vessels, which gives lodgement to ligaments connecting it and the os calcis; this groove marks the neck of the astragalus *inferiorly*; the anterior articulating surface is therefore placed on the under surface of the head of the astragalus, which here presents another articular surface, frequently confounded with the former, where the head rests *inferiorly* on the calcaneo-navicular ligament; they may be easily distinguished by the latter being larger, convex and continuous with the articular surface on the anterior part of the head of the astragalus for the navicular bone, *posteriorly* the astragalus is of small extent, rough, and is marked by a deep groove directed obliquely downwards and inwards, which gives lodgement to the tendon of the flexor longus pollicis, and into the edges of which the internal lateral ligament of the ankle joint

is implanted; *above* this groove is a transverse rough surface of small extent, into which ligaments are implanted, *anteriorly* it terminates in the *neck*; this is the most contracted part of the bone placed in *front* of the body and *behind* the head; its situation is marked *superiorly* by a rough groove which gives attachment to several of the ligaments of the ankle joint, *inferiorly* by the deep groove already described, as separating the inferior two articulating surfaces of the astragalus; *internally* and *externally* by superficial rough surfaces, also giving attachment to ligaments; this part of the bone is exceedingly rough and porous for the transmission of vessels, and is not marked by any articular surface; the *head* of the astragalus is placed in front of the neck, directed obliquely forwards and inwards; it is marked *anteriorly* by an oblong articular surface convex, and directed downwards and inwards, which is received into the os naviculare in front, and is prolonged *inferiorly* into the articular surface already described as supported by the calcaneo-navicular ligament. The astragalus articulates with four bones; the tibia *above* and *internally*, the fibula *externally*, the os calcis *inferiorly*, and the os naviculare *anteriorly*. To place it in situ, its largest articular surface must look upwards and inwards; its convex articular surface for the os naviculare forwards and inwards, and the deep groove downwards, in such a position as that the external edge of its superior articular surface may be the highest part of the bone.

The *Os Calcis* is the largest bone of the tarsus; it is placed in the *posterior*, *inferior*, and *external* part of the foot, between the astragalus *superiorly* and a

little *internally*, and the os cuboides *anteriorly*, and is situated so as to bear nearly the whole weight of the body ; it is of a very irregular shape, presents a remarkable projection posteriorly beyond the other bones of the tarsus, termed the *tuberosity* or *heel*, reaches *anteriorly* as far as on a line with the head of the astragalus ; it is elongated from behind forwards, of considerable vertical height, but narrow in the transverse direction ; *superiorly* we observe, as we traverse the bone forwards, a tolerably rough surface, concave antero-posteriorly, convex from side to side, between the tuberosity behind, and an articulating surface in front, which gives lodgement to a quantity of fat, and receives the posterior edge of the tibia in forced extension of the ankle joint, *an articulating surface*, convex, directed forwards and outwards, which is received into the concave articulating surface on the under surface of the astragalus ; *in front* of this, and at its *inner* side an extensive, rough surface corresponding to the groove on the astragalus, for the attachment of ligaments ; still more *forwards* and *inwards*, another cartilaginous surface, oblong, narrow, irregular, concave, directed forwards and outwards for articulation also with the astragalus ; this rests on a projecting part of the bone, termed the *sustentaculum* or *lesser tuberosity* of the os calcis ; the *inferior surface* is much narrower than the *superior*, and presents no articular surface ; it is irregular, concave from behind forwards, convex transversely ; on it *posteriorly* are two tuberosities, the *internal* one larger and more anterior, the external one smaller, for the origin of muscles and ligaments, and separated by a superficial groove which, with the surface anterior to this, serves for

the attachment of muscles and the ligamentum longum or calcaneo-cuboid ligament, etc.; the *external surface* of the os calcis is irregularly convex and rough; it is more extensive behind than before, and is separated into a *posterior* and *anterior* part, by a tubercle; the *posterior* part is slightly concave and subcutaneous; the *anterior* is grooved superficially for the passage of the tendons of the peronæus longus, and brevis, in front of which, it is rough for the attachment of ligaments, and for the origin of the extensor brevis muscle; the *tubercle* affords insertion to the external lateral, or perpendicular ligament of the ankle joint; the *internal surface* is smooth and concave, and forms a remarkable arch for the passage of the vessels and nerves, to supply the sole of the foot and the tendons of the tibialis posticus, flexor communis, and flexor longus pollicis muscles; this last tendon passes through a groove, marked on the *inferior* surface of the sustentaculum; from the upper part of this surface projects the *sustentaculum* of the os calcis, a remarkable process which deepens the arch considerably, and gives attachment to the internal lateral and calcaneo-navicular ligaments *inferiorly*, and presents *superiorly* an articular surface for supporting the astragalus; *posteriorly* the os calcis is convex, and forms the projection, termed the *tuberosity* or *heel*—this is rough *inferiorly*, where it gives insertion to the tendo achillis; smooth superiorly, where it corresponds to a bursa, separating it from this tendon; *anteriorly* this bone presents a smooth cartilaginous surface, concave downwards and outwards, convex downwards and inwards for articulation with the os cuboides. The os calcis is

articulated with two bones, the astragalus *superiorly*, the os cuboides *anteriorly*. To place it in situ the tuberosity must be directed backwards; the articular surface for the os cuboides forwards, and a little outwards; its concave surface inwards; its convex outwards; its two superior articulating surfaces upwards.

The *Os Naviculare* or *scaphoid* bone is situated in the internal, and nearly the central part of the tarsus, between the astragalus behind, the three cuneiform bones in front, and the cuboid bone externally, of an oval or rather ovoid form; its longest axis directed obliquely downwards and inwards; its larger extremity turned upwards and outwards; its *circumference*, more extensive externally than internally, is rough and irregular for the attachment of ligaments, except on its outer part where it is sometimes smooth for articulation with the os cuboides; from it *inferiorly* and *internally* descends a remarkable projection, sloping a little backwards, for the insertion of the tibialis posticus tendon, and the calcaneo-navicular ligament: this is our guide in Chopart's amputation of the foot; *posteriorly* the os naviculare is smooth and concave, and presents an articular surface, ovoid in shape, directed obliquely downwards and inwards, resembling the glenoid cavity of the scapula, which receives the convex head of the astragalus; *anteriorly* it is convex, and marked by three articular surfaces for the three cuneiform bones; of these, the *internal* directed forwards and inwards, is larger and more convex than the others, and has its larger extremity turned *downwards*, whilst the others, smaller, have their larger extremity turned *upwards*, and look almost

directly forwards, the *external* being directed a little outwards, they are separated by a slight projection of the cartilage, more observable between the external and middle, than between this and the internal. The os naviculare articulates with five bones; the astragalus *posteriorly*, the three cuneiform bones *anteriorly*, and the os cuboides *externally*. To place it in situ its narrow projecting part must be directed downwards and inwards; its largest extremity upwards and outwards; its concave surface backwards; its convex, forwards.

The *Os Cuboides* or *cuboid bone*, is situated in the anterior and outer part of the tarsus, between the os calcis posteriorly, the outer two metatarsal bones anteriorly, and the os naviculare, and external cuneiform bone internally; it is somewhat cubical in shape, but is larger and thicker *internally* than *externally*; its *superior surface* directed also a little outwards, rough and irregular for the attachment of ligaments, is covered by the extensor brevis muscle; its *inferior surface* is divided into two, a *posterior* and *anterior*, by a projection running forwards and inwards; the *posterior* large and concave, gives attachment to the calcaneo-cuboid ligament; the *anterior* smaller, is deeply grooved for the tendon of the peronæus longus muscle; the *ridge* gives attachment to the calcaneo-cuboid ligament; internally, the cuboid bone is irregular, and marked by two articulating surfaces, one *posterior* and *inferior*, sometimes wanting, articulates with the astragalus; the other *superior* and *anterior*, occupying nearly the centre of the bone, and near its upper edge, smooth and plane, articulates with the external cuneiform bone; round this articulation it is rough for the

attachment of ligaments, *externally* it is of small extent and thin, and is marked by a deep groove for the passage of the peronæus longus tendon; the ridge bounding this groove *posteriorly* is frequently encrusted with cartilage, which corresponds to a sesamoid bone formed in the tendon, where it is here exposed to considerable friction; *posteriorly* this bone presents an articulating surface, irregularly convex from above downwards, concave transversely for articulation with the os calcis; *anteriorly* is an articulating surface also, directed a little outwards, and imperfectly divided into two plane articulating surfaces, of which the *internal* is square, and corresponds to the fourth metatarsal bone, the external, triangular for articulation with the fifth metatarsal bone. The os cuboides articulates with four bones; the os calcis posteriorly, the two outer metatarsal bones anteriorly, the external cuneiform bone internally, and also sometimes, the astragalus. To place it in situ the deep groove in it must be directed downwards, a small part of it looking outwards; its irregular articular surface backwards and outwards, and its non-articular and smallest surface outwards, and a little downwards.

The *Cuneiform bones* are three in number, the *internal*, *middle*, and *external*, so named from their position in the foot, not from their size, as the middle is the smallest, they are wedge-shaped, and occupy the *internal* and *anterior* part of the tarsus, but nearly in the centre of the foot. The *internal cuneiform bone* is placed at the inner side of the foot between the os naviculare posteriorly, the first metatarsal bone anteriorly, and the extremity of the second metatarsal and middle cuneiform bones

externally; it is like the others, wedge-shaped, but the apex of the wedge is turned *upwards*, the base *downwards*; it is of much greater vertical than transverse extent, and occupies more of the sole than of the dorsum of the foot; it is a little curved on itself, the concavity outwards, so as to support the apex of the second or middle cuneiform bone inferiorly; its *internal* surface is larger than the others, is rough and irregular for the attachment of the tibialis anticus tendon, which is implanted near to its inferior part; the *external* surface is also irregular and is marked by two articular surfaces continuous with one another superiorly, an *anterior*, and a *posterior*; the *anterior* exceedingly small and nearly plane, articulates with the second metatarsal bone, the *posterior* larger with the middle cuneiform bone; *inferiorly* it is rough and convex, and presents a superficial eminence for the attachment of the tibialis posticus and anticus tendons which here meet; *superiorly* it terminates in a narrow pointed edge; *posteriorly* it presents a concave ovoid articular surface with its long axis directed downwards, larger below than above for articulating with the navicular bone; *anteriorly* it is irregularly convex, directed a little inwards, and projects considerably beyond the rest of the tarsal bone; it is here articulated with the first metatarsal bones. The internal cuneiform bone articulates with four bones; the os naviculare posteriorly; the first metatarsal bone anteriorly, and the second metatarsal and middle cuneiform externally. When in situ its apex is turned upwards and slightly outwards; its base downwards; its concave articular surface backwards, and its rough non-articular surface inwards.

The *middle cuneiform* bone is the smallest of the three, and is placed between the other two on the sides, the navicular bone posteriorly, and the second metatarsal bone anteriorly; its *apex* is turned *downwards* towards the sole of the foot, and gives attachment to ligaments; its *base* is turned *upwards*, is rough, quadrilateral and convex, and also gives attachment to ligaments; *internally* it is marked with a slightly convex articular surface on its upper part for the internal cuneiform bone, beneath which it is rough for the insertion of ligaments; *externally* is an articular surface, a little concave, at its posterior edge, for the external cuneiform bone in front of which it is rough and gives attachment to ligaments; *posteriorly* it presents a slightly concave articular surface for the navicular bone; and *anteriorly* an articular surface irregularly convex for the second metatarsal bone. The middle cuneiform bone articulates with four bones, the internal and external cuneiform bones on either side, the navicular bone posteriorly, and the second metatarsal bone anteriorly. To place it in situ, its base must be turned upwards, its apex downwards; its triangular concave articular surface backwards; its convex triangular surface forwards, and its convex lateral surface inwards.

The *external cuneiform bone* is the middle as to size, it is situated external to the preceding between it, the cuboid bone externally, the navicular bone posteriorly, and the third metatarsal bone anteriorly, its *apex* is also turned downwards, is rough and gives attachment to ligaments, its *base* upwards, quadrilateral and rough for the same purpose, *internally* it presents two articular surfaces, an anterior and posterior, separated by a rough surface of small

extent, the anterior situated at the upper edge of the bone is exceedingly small, and articulates with the second metatarsal bone; the posterior is larger, irregular and convex, and articulates with the middle cuneiform bone, *externally* are also two articular surfaces separated by a large interval, the anterior articulates with the fourth metatarsal bone; the posterior is larger and concave, and articulates with the cuboid bone, *posteriorly* it is marked with an articular surface nearly plane, looking a little inwards for connexion with the navicular, and *anteriorly* by another articular surface of the same shape for articulation with the third metatarsal bone. The external cuneiform bone articulates with six bones, internally with the middle cuneiform and second metatarsal bones, externally with the os-cuboides and fourth metatarsal bone, posteriorly with the os-naviculare, and anteriorly with the third metatarsal bone. To place it in situ the base must look upwards and a little outwards; the apex downwards; its posterior articular surface a little inwards, and the two small lateral articular surfaces outwards.

The structure of the tarsal bones is the same as that of all irregular bones, that is, spongy in the centre, covered by a thin layer of compact tissue; they are developed from one centre of ossification, with the exception of the os-calcis and the astragalus which have two; at birth they are almost altogether cartilaginous, especially the three cuneiform bones.

The Metatarsus is composed of five bones called metatarsal, and named in their numerical order from within outwards; they belong to the class of long bones, and consist each of a *posterior* or *tarsal* extremity, an *anterior* or *phalangeal* extremity or

head and a centre or body. Their *posterior* extremities are nearly plane and irregular, and articulate with one or more of the tarsal bones; laterally they present articulating surfaces where they are applied against one another or one of the tarsal bones, and rough depressions for the attachment of ligaments; superiorly and inferiorly they are rough and irregular, and give attachment to ligaments and tendons; their *anterior* extremity or head is convex and oval, the long axis directed from above downwards, and is covered by cartilage which extends farther towards the sole than the dorsum of the foot for articulation with the first phalanx of each toe; *on each side* of this are eminences for the attachment of ligaments, separated from the articulations by grooves; the *body* of each metatarsal bone is triangular and smaller than the extremities, convex, and large *superiorly* where they are covered by the extensor tendons, concave and small *inferiorly*, where they are covered by the muscles of the sole of the foot; they leave intervals between them filled by the interossei muscles. The first *metatarsal bone* is the shortest and strongest, its posterior extremity is irregularly concave, elongated from above downwards, and resembles somewhat the shape of the human ear, for articulation with the internal cuneiform bone; on its *outer* edge is a small articular surface for the second metatarsal bone; it presents *inferiorly* and *externally* a tubercle, into which the peronæus longus tendon is inserted; its anterior extremity or head is quadrilateral and marked inferiorly by two grooves, separated by a ridge; which give lodgement to the two sesamoid bones, of its three surfaces one is turned upwards and a little inwards, is a little convex and subcutaneous,

another inferior directed downwards, is concave and covered by the flexor brevis pollicis muscles, the third is external, concave, and corresponds to the first dorsal interosseous muscle above, to the abductor pollicis below; it articulates with five bones, the internal cuneiform, the second metatarsal, the first phalanx, and two sesamoid bones; connected with the first metatarsal bones are two irregular bones termed sesamoid, situated in the grooves already described on the under surface of the head; they give attachment to numerous muscles, and obviate the effects of friction. The second *metatarsal bone* is the longest; its *posterior* or *tarsal* extremity is concave and triangular, is wedged in between the three cuneiform bones, and is supported by the second; *internally* it presents two small articular surfaces, a superior posterior one for the internal cuneiform bone, an inferior anterior for the first metatarsal bone; *externally* two articulating surfaces also, a superior and inferior, both convex and articulated *posteriorly* with the external cuneiform bone, *anteriorly* with the third metatarsal bone; its *anterior* extremity is articulated with the first phalanx of the second toe; of its three surfaces, the *internal*, convex, the *external* concave correspond to the interossei muscles, the *inferior* is concave and covered by the muscles in the sole of the foot, *superiorly* it is narrow, convex and covered by the extensor tendons; it articulates with six bones, the three cuneiform bones, the first and second metatarsal bones and the first phalanx of the second toe.

The *third metatarsal bone* is shorter than the preceding, *posteriorly* it articulates by means of a triangular concave surface with the third cuneiform

bone, *internally* it is marked by two smooth articular surfaces separated by a small interval for articulation with the second metatarsal bone; *externally* it has a large triangular articular surface for the fourth metatarsal bone; its *anterior* extremity and *body* are similar to the preceding; it articulates with four bones, the external cuneiform, the second and third metatarsal bones, and the first phalanx of the third toe.

The *fourth metatarsal bone*, a little shorter than the preceding, has nearly the same form; its *posterior* extremity presents a quadrilateral articular surface, irregularly convex for connexion with the cuboid bone; *internally* a triangular convex surface, the anterior part of which is joined to the third metatarsal bone, and the posterior to the external cuneiform bone, *externally* a triangular concave articular surface for junction with the fifth metatarsal bone; its anterior extremity and body resemble the preceding; it articulates with five bones, the cuboid and external cuneiform, fourth and fifth metatarsal bones posteriorly, and the first phalanx of the fourth toe anteriorly.

The *fifth metatarsal bone* is a little shorter than the preceding, but projects posteriorly more than the other metatarsal bones; *posteriorly* it is marked by a convex articular surface, directed inwards for the cuboid bone; *internally* a convex surface also for the fourth metatarsal bone; externally a large tubercle, directed backwards and inwards, which gives attachment superiorly to the tendon of the peronæus tertius muscle; posteriorly to that of the peronæus brevis, and inferiorly to the abductor minimi digits; this is our guide in Hey's Amputation of the Foot; its

anterior extremity resembles the preceding, but is smaller; its *body* is much larger posteriorly than anteriorly, its superior surface is inclined outwards, and is nearly subcutaneous; its *inferior* and *internal* surfaces give attachment to muscles; it articulates with but three bones: the cuboid and fourth metatarsal bone posteriorly, the first phalanx of the fifth toe anteriorly.

The *structure* of the metatarsal bones is the same as that of all long bones, compact in the centre, spongy in the extremities, and possessed of a medullary canal. They are developed by two points of ossification, one for the body and one for the anterior extremity, with the exception of the first, which has the second point of ossification at its posterior extremity. The student may observe, that the internal three metatarsal bones are supported, each by one of the cuneiform bones posteriorly; but that the outer two rest on the cuboid bone alone. The *Phalanges* constitute the toes; they are fourteen in number, three for the four outer toes, and but two for the internal or great toe; they are called the first or metatarsal, the second or middle, the third or ungual phalanx. The *first* or *metatarsal* phalanges are much larger and longer than the others; the *posterior* extremity is concave, and articulates with the heads of the corresponding metatarsal bones—beneath it are two tubercles which give attachment to the lateral ligaments of the articulation; the *anterior* extremity is elongated and concave transversely, convex from above downwards, and resembles the inferior extremity of the femur in miniature; on each side is an indentation for the attachment of the lateral ligaments; the centre or

body is convex *superiorly*, and covered by the extensor tendons, concave *inferiorly* to afford lodgement to the flexor tendons, laterally concave and covered by the tendons of the lumbricales and interossei muscles. The *second* or *middle* phalanges are next in size and situation; their *posterior* extremity is elongated and convex transversely, concave from above downwards to correspond to the opposed surface on the first phalanx; their anterior extremity and body resemble those of the preceding in shape; their *inferior* surfaces give attachment laterally to the tendons of the flexor brevis digitorum. The first toe has no middle phalanx. The *ungual*, or *third* or *last* phalanx, is exceedingly small and triangular; that of the first toe much larger than the others; the posterior extremity resembles that of the second phalanx, *anteriorly* it terminates in a rough point, which supports the nail, and gives insertion to the extensor tendons superiorly, and inferiorly to those of the flexor longus digitorum pedis. The first phalanges belong to the class of long bones; the second and third are chiefly spongy in their structure, they are developed by one, and sometimes two points of ossification.

SECTION II.

THE ARTICULATIONS OF THE LOWER EXTREMITY.

The articulations of the lower extremity consist of the *hip joint*, or *ilio-femoral articulation*; the *knee joint*; the *superior and inferior tibio-fibular articulations*; the *ankle joint*, and the *articulations of the foot*.

THE HIP JOINT, OR ILIO-FEMORAL ARTICULATION.

This articulation is formed by two bones, the *os innominatum* and the *femur*.

The *os innominatum* presents in its contracted part an excavation termed the acetabulum, which receives the head of the femur, and forms with it] the ilio-femoral articulation; this is a deep cup-like cavity, placed nearly in the *centre*, but rather in the *anterior* part of the pelvis, between the anterior superior spinous process of the ilium *above*, the tuberosity of the ischium *below*, the thyroid foramen and the pubis *in front*, and the sciatic notch *behind*; it is nearly circular in shape, and is surrounded by a projecting lip of bone, strong and prominent towards its *upper* and *back* part, projecting but little *anteriorly* and *superiorly*, where it is formed by the os pubis, and altogether deficient *internally* and *inferiorly* towards the thyroid foramen, where it presents a deep notch converted by the cotyloid ligament into a foramen, which serves for the transmission of vessels to supply the head of the femur; its cavity is lined by cartilage, except *at* the *anterior inferior* part, where we see a rough, irregular surface for giving origin to the

ligamentum teres, and lodgement to a quantity of fatty substance, formerly called Haversian glands; this cartilage is thicker at the *superior* part of the acetabulum, where it rests on the upper surface of the head of the femur, and is of much greater depth at the circumference than in the centre, like all cartilage lining concave surfaces; the *aspect* of the acetabulum is downwards, forwards, and outwards; its depth is from an inch to an inch and a half. In the young subject it is formed by three bones, the *ilium*, *ischium*, and *pubes*; the ilium forming nearly two-fifths, the ischium more than two-fifths, the pubis one-fifth.

The parts of the *femur* which assist in forming this articulation are, the *head* and part of the *neck*. The *head* of the femur is a round convex eminence, situated at its *upper* and *internal* part, of a somewhat spherical shape, covered by cartilage, and forming about two-thirds of a sphere; it is received into the cavity of the acetabulum, but is never entirely covered by it; on examining it we may observe that the cartilage extends more *outwardly* on its superior than its inferior surface, manifestly because it is here in more extensive contact with the acetabulum in the different motions of the joint, and terminates rather abruptly in a waiving, irregular line, surrounding the head of the bone; nearly in its centre, but a little posterior and inferior to it is a depression for receiving the insertion of the ligamentum teres; this cartilage, like all cartilages lining convex surfaces, is thicker in the centre than in the circumference; the *aspect* of the head of the femur is upwards, forwards, and inwards. The *neck* of the femur is that oblique process of bone which

supports the head on the shaft of the femur, and deserves the student's closest attention; it is of a triangular shape; its *apex* at the head of the bone, where it is rounded; its *base* at the shaft, where it becomes flattened, and terminates, *anteriorly* and *posteriorly* at the anterior and posterior intertrochanteric lines, *superiorly* and *inferiorly* at the greater and lesser trochanters; *superiorly* the neck of the femur is of short extent, and concave for the purpose of allowing of abduction of the femur, inferiorly it is also excavated, but is much longer, and looks downwards and inwards; the *anterior* surface of the neck of the femur is nearly plane, it presents numerous foramina for the transmission of blood vessels; the *posterior* surface is deeply excavated to allow of rotation outwards, is much more extensive than the anterior, is rough from the passage of blood vessels, and gives insertion about its centre to the capsular ligament; the neck with the head of the femur is directed from the shaft of the bone, which it joins at an acute angle above, an obtuse one below, upwards, forwards, and inwards. The neck of the femur differs in the *female* subject—in her, it is much longer and more rounded, not so triangular, and is directed more transversely; in the *old* subject it becomes transverse, shortened considerably, and undergoes a process of interstitial absorption which removes most of its animal matter, and thus gives rise to its being frequently fractured at this period of life, and especially in the female subject—in the young subject it hardly exists.

THE LIGAMENTS OF THE HIP JOINT.

The *ligaments* of the hip joint are the *capsular* and the *accessory* ligaments situated *externally*; the *cotylloid ligament* and *ligamentum teres* *internally*.

The *Capsular* ligament is that ligament which may be seen to surround the bones like a capsule or bag, and is by far the strongest and most perfect in the human body; it arises *superiorly* from the outer surface of the brim of the acetabulum beyond the cotylloid ligament, passes from this downwards and outwards, envelopes the head of the bone, and is inserted into the neck which it closely embraces, extending *anteriorly* as far as the anterior inter-trochanteric line; but *posteriorly* only as far as about three-fourths of an inch from the posterior inter-trochanteric line; an important fact which explains how fracture of the neck of the femur can occur partly within and partly without the capsular ligament; this ligament is of a conical shape, wide superiorly, contracted inferiorly; it is strong and thick *posteriorly* where it is strengthened by the tendinous origin of the rectus femoris muscle, in order to oppose dislocation in this direction, and *anteriorly* owing to the existence here of the accessory ligament; it is thin and weak towards the thyroid foramen, and yet the bone is but seldom dislocated in this direction; it is perforated by the tendon of the rectus femoris muscle; on its *external* surface it is covered by numerous muscles which assist in strengthening the joint; on its *inner* surface it is lined by synovial membrane.

The *accessory ligament* is situated on the *anterior*

part of the joint; it arises narrow from the anterior inferior spinous process of the ilium, expands, passes downwards, backwards, and outwards, and is inserted into the lesser trochanter; it strengthens the articulation in front, supports the head of the femur, and presents too great extension of the joint; it is covered by the psoas magnus and iliacus internus muscles *anteriorly*, from which it is separated by a large bursa which sometimes communicates with the joint; *posteriorly* it is identified with the capsular ligament.

Let the Student now divide the capsular ligament *first* round the neck of the femur, and he will find that with all his efforts he cannot remove the head of the bone, so closely is it encircled by this ligament; to this fact he must attend in performing amputation at the hip joint; then let him divide it close to the acetabulum and he will easily withdraw the bone, although indeed the atmospheric pressure may give some resistance; he will, by this means, expose the *interior* of the joint, containing the *ligamentum teres* or *inter-articular* ligament, the *cotylloid* ligament, and the synovial membrane.

The *ligamentum teres*, or *inter-articular* ligament, arises from the rough surface in the bottom of the acetabulum by two heads, one from each side of the notch in its circumference, passes upwards and outwards, and is implanted into the depression in the head of the femur; although termed round, it is rather of a triangular shape; its base at the acetabulum where it is thin, flat and bifurcated; its apex at the femur where it is a little rounded; its two heads are separated by the vessels passing to the head of the bone, branches of the obturator and internal circumflex arteries, the con-

ducting of which seems to be its principal use, it is stretched in adduction, relaxed in abduction, of the thigh ; it is of little use as a ligament, as the femur may be removed almost completely out of the acetabulum and placed in the thyroid foramen without its division.

The *cotyloid* ligament surrounds the brim of the acetabulum to which it is firmly attached ; when it arrives at the notch in the circumference of the bone it terminates in two extremities which pass to the opposite sides of the notch where they are firmly implanted, and into the bottom of this cavity, that from the inferior part of the circumference of the acetabulum going internal to the other ; it is of a triangular shape, its base at the bone, its apex free ; it is deeper at the upper and back part of the acetabulum than elsewhere ; its *structure* is fibro-cartilaginous, its fibres running obliquely towards the bone ; it is continuous with the tendon of the rectus femoris muscle, and is lined by synovial membrane ; its *use* is to deepen the cavity of the acetabulum without interfering with the motion of the joint. A few fibres pass in a transverse direction across the notch beneath the cotyloid ligament, which have received the name of *transverse* ligament ; they are seldom so distinct as to deserve a separate name ; they are intimately connected with the cotyloid ligament.

The *interior* of the hip joint is lined like other articulations by the *synovial membrane* ; we may commence its description at the insertion of the ligamentum teres into the head of the femur ; from this it spreads out and invests the head of the bone, then passes on the neck where it is thrown into

numerous folds termed *retinacula*, it envelopes the neck nearly as far outwardly as the attachment of the capsular ligament; from this is reflected on the capsular ligament, leaving a small triangular interval between it and the bone where it does not line this ligament; it now lines the under surface of the capsular ligament, which conducts it to the os innominatum external to the cotyloid ligament, and leaves here also a triangular interval; it now covers the outer surface of this ligament, lines its free edge, passes on its internal surface, and then sinks into the acetabulum lining its cavity, and forming folds where it covers the fatty substance in the bottom of the articulation, which has received the name of Haversian glands; from this it passes on the ligamentum teres surrounding it, and is conducted by it to the head of the femur, from which we set out.

The hip joint belongs to the class of *Enarthrodial*, or *Ball and Cup* articulations; its motions are very extensive, and comprise *flexion*, *extension*, *abduction*, *adduction*, *rotation*, and *circumduction*; *flexion* of the hip joint is bending it towards the trunk; this is limited only by the thigh striking the anterior surface of the abdomen; *extension* is restoring the limb to the vertical position; this motion is limited by the accessory ligament in front, which thus prevents us bringing the thigh behind a straight line with the body; we appear, however, when standing on one leg, to have the power of even flexing the hip joint backwards; this motion does not take place in the hip joint but in the pelvis, the lumbar vertebræ, and in the opposite articulation; were this motion not restrained, dislocation forwards and upwards on the pubis would frequently occur, owing to the deficient

state of the brim of the acetabulum in this situation. *Abduction* is separating the thigh from the opposite ; it is extensive, and is restrained by the tension of the muscles on the inner side of the thigh, and by the great trochanter pressing against the os innominatum. In modern days some individuals can abduct the thigh, so as to form a right angle with the body ; *adduction* is approximating the thighs, and is limited by the opposite limb ; *rotation* of the hip is the rotation of the femur on its own axis, that is, on a line drawn from the centre of the articulation to the centre of the lower extremity of the limb ; it is very extensive, owing to the great length of the neck of the femur enabling the upper part of the thigh to move through a considerable semicircular space as may be felt on placing the hand on the trochanter major ; *circumduction* of the hip is that motion in which we describe a cone with the limb, the apex at the hip, the base at the foot ; it is also extensive. The hip is contrasted with the shoulder joint in these two latter motions ; the former, that is rotation, being more extensive in the hip ; the latter, that is circumduction, being more extensive in the shoulder joint. The Student cannot study the relative anatomy of the acetabulum too attentively, particularly its relations to the anterior superior spinous process of the ilium, the sciatic notch, thyroid foramen, etc., as also the relative bearings of the head of the femur and great trochanter to all those parts ; they are of material service in distinguishing dislocations of this joint.

THE KNEE JOINT.

The *Knee joint* is formed by three bones; the *femur* above, the *tibia* beneath, and the *patella* in front.

The part of the *femur* which enters into this articulation is its inferior extremity where it presents for this purpose two oval convex eminences, elongated in the antero-posterior direction, and encrusted with cartilage termed *condyles*; of these one is called *internal*, the other *external*. The Student should pay particular attention to their anatomy; their shape, differences, etc., as they seem to influence the remaining structures of the joint, and to be the model, as it were to correspond with which these are formed; they differ in almost every particular. The *internal condyle* is longer than the external, that is, projects more inferiorly, so that if we place the shaft of the bone in the vertical position, this will alone rest on a plane surface, (it does not descend, however, when articulated lower than the other,) by this means the obliquity of the shaft of the femur is counteracted, the weight of the body is thrown on the internal lateral ligament of the joint rather than on the bones, and the leg is enabled to descend vertically from the femur, so that the limbs may not cross one another inferiorly, which would occur had they been articulated in the same line with the femur; it is longer from before backwards, but shorter in the transverse direction; it projects more *posteriorly*, and is here covered more by cartilage, because in extreme flexion of the knee this condyle is in contact with a larger surface of the tibia, whilst the external condyle

projects more *anteriorly* to prevent dislocation of the patella outwards so likely to occur, and is encrusted more with cartilage that it may articulate with this bone; the external condyle is *nearly* on a line with the shaft of the bone, whilst the internal is on a plane internal to it; in the very recent state the cartilage on the condyle is divided into two parts, an anterior, and posterior, by a transverse ridge of cartilage, (not observable in the dried bone); the anterior is the smaller, and articulates with the patella in flexion of the knee; the posterior larger and somewhat elongated, is in contact with the tibia; *anteriorly* is an articular surface concave from side to side, for the reception of the patella in the *extended* position of the joint, and termed the *anterior intercondyloid fossa*. The cartilage lining those condyles is thickest in the centre.

The superior extremity of the *tibia* which assists in forming the joint is of an oval shape, elongated transversely, and is marked with two concave articular surfaces for the reception of the condyles of the femur, and correspond to them; they are also termed *condyles*, an *internal*, and an *external*; the *internal* is longer from before backwards than the external, shorter transversely, is more excavated to receive the greater projection inferiorly of the internal condyle of the femur; the external is but slightly concave, and slopes from within outwards, these two surfaces are separated by the spine of the tibia, and a rough surface in front of, and behind it, so that their cartilaginous surfaces are not continuous as those of the femur are; the cartilage lining them is thickest at the circumference.

The part of the *patella* which enters into this

articulation is its *posterior* surface; this, like the bone itself, is triangular in shape; the apex inferiorly, the base superiorly; it is lined by cartilage, and is divided by a nearly vertical ridge into an external and internal part, the former larger and concave, corresponds to the articular surface on the external condyle of the femur, the latter small and convex, to that on the internal condyle.

THE LIGAMENTS OF THE KNEE JOINT.

The ligaments of the knee joint are divided into those on the outer surface of the joint, and those in its interior. The external ligaments are the *ligamentum patellæ*, the *external* and *internal lateral ligaments*, and the *ligamentum posticum* of Winslow; the *internal* are the *two alar ligaments*, the *ligamentum mucosum*, the *transverse ligament*, the *two crucial ligaments*, and the *ligament of Wrisberg*. On stripping off the integuments from around the knee-joint to expose the ligaments, the Student may observe that this articulation is strengthened by an aponeurotic expansion derived from the fascia lata, and the vasti muscles; this is much stronger *externally* than *internally*, and passes inferiorly in a transverse direction across the *ligamentum patellæ*, which it here binds firmly down; on raising this we bring into view, in front of the patella, the parieties of a large bursa mucosa which covers the anterior surface of this bone, and is interposed between it and the expansion from the extensor tendons; its use is to obviate the effects of friction in the motion of the joint; in its interior this bursa is smooth and occasionally traversed by fibrous bands the result of inflammation; below this

is a very small and indistinct bursa in front of the *ligamentum patellæ*.

The *ligamentum patellæ* is a strong fibrous structure, which arises *superiorly* from the apex of the patella, passes downwards and outwards, and is inserted *inferiorly* into the lower part of the *tubercle* of the tibia; it is about two or three inches in length, narrow in the centre, expanded at either extremity, especially at its upper part, where it is at least an inch or an inch and a half in breadth; its *outer* edge is better defined and longer than the *internal*; its *anterior* surface is covered by the tendinous expansion and small bursa already described; its *posterior* corresponds, from above downwards, to a large quantity of fat which here separates it from the synovial membrane of the joint; below this, to the upper extremity of the tibia, and most inferiorly to a large bursa, which separates it from the smooth surface on the upper extremity of the tibia, and the superior part of the tubercle. The use of this ligament is to act as an insertion to the extensor tendons, into the upper part of the tibia, through the intervention of the patella. Although called ligament, it is more properly a tendon; *originally* it was the continuation of the rectus femoris tendon, the patella being developed in its structure, to obviate the effects of friction; like tendons, it is smooth and polished, and its fibres are longitudinal. Its prolonged insertion into the tubercle of the tibia enables us to amputate the leg through the lower part of this eminence.

The *external lateral ligament* is placed, as its name implies, on the outer side of the joint; it is a round, fibrous chord, arises *superiorly* from an eminence

on the external condyle of the femur, immediately above the depression for the poplitæus tendon, passes *downwards, backwards, and outwards*, and is inserted into the upper extremity or head of the fibula, between the tendinous insertions of the biceps flexor cruris; there is sometimes a second external lateral ligament situated posterior to the first; it is much smaller, arises from the fibula, passes upwards, and is inserted either into the external semi-lunar cartilage, or into the external condyle of the femur; when it exists the two ligaments interlace with the insertion of the biceps tendon; on its *outer* surface the external lateral ligament is covered by the integuments and a tendinous aponeurosis, derived from the vastus externus muscle and fascia lata, *internally* it corresponds from above downwards; to the tendon of the poplitæus muscle and to the synovial membrane; to the external semi-lunar cartilage, from which it is separated by the external inferior articular artery, and to which it is but slightly attached, and lastly to the upper extremity of the tibia.

The *internal lateral ligament* is placed on the inner side of the joint; it is a broad flattened band, is attached superiorly to the eminence on the inner surface of the internal condyle, passes downwards and forwards, and is inserted inferiorly into the inner surface and anterior edge of the upper extremity of the tibia; this ligament is from three to four inches in length, is from an inch to an inch and a half in breadth; it is continuous *superiorly* with the adductor magnus tendon; is expanded *in the centre*, where it intimately adheres to the internal semi-lunar cartilage; is narrow, and pointed *inferiorly*; its *anterior* edge

is well marked; its *posterior* edge is gradually lost in the posterior part of the joint; its *internal surface* is covered by the integuments *superiorly*, and by the tendons of the sartorius, gracilis, and semitendinosus inferiorly, and is here covered by a bursa, which gives it a smooth, polished appearance; its *outer* or *articular surface* corresponds to the lower extremity of the femur, to the internal semi-lunar cartilage, to the anterior insertion of the semimembranosus muscle, and to the internal inferior articular artery, both of which separate it from the tibia. These ligaments are placed nearer the posterior than the anterior part of the joint, and differ in almost every particular, as may be seen from the preceding description.

The *ligamentum posticum* of Winslow is placed in an oblique direction at the posterior part of the joint, filling up the posterior intercondyloid fossa; it is implanted inferiorly into the internal and posterior part of the tibia, passes upwards and outwards, and is inserted into the external condyle of the femur; it is perforated by the azygos artery, a branch of the poplitæal, and may be considered as being derived from, and forming one of the insertions of, the semimembranosus muscle; its *posterior* surface has, resting on it the poplitæal artery, from which it is separated by a lymphatic gland; its *anterior* corresponds to the articulation. These are the external ligaments of the knee joint; to expose the interior of the articulation, the student should make a transverse incision about one inch above the patella, and then from it carry downwards two longitudinal incisions, one on either side of this bone, and then throw down the flap containing the patella; he will thus expose the interior of the joint containing the

ligaments already enumerated, and the two semi-lunar cartilages, lined by synovial membrane.

The *two alar ligaments* are folds of the synovial membrane; they arise gradually on either side of the patella, pass downwards, converge, and become united inferiorly, where they form an angle, from which arises the following ligament.

The *ligamentum mucosum* arises from the angle formed by the preceding, passes upwards and backwards, and is inserted into the depression between the condyles of the femur, it is exceedingly small and weak, and is sometimes wanting.

The *transverse ligament* is situated immediately in front of the anterior extremities of the semi-lunar cartilages, generally concealed by cellular and fatty substance, and is even occasionally wanting; it arises from the anterior convex extremity of one semi-lunar cartilage, passes transversely across the tibia, and is attached to the corresponding extremity of the other; its use is to connect the two cartilages together, so as to prevent their separation when the femur rests on their superior surface.

The *crucial ligaments* are two in number: an *anterior* and *posterior*; and may be seen stretching obliquely from the femur to the tibia, in the centre of the joint; they are called crucial, from their crossing one another both antero-posteriorly and transversely, and have received their names of anterior and posterior from their attachment to the *tibia*.

The *anterior crucial ligament* arises superiorly from the internal surface and posterior part of the external condyle of the femur, passes downwards, forwards, and inwards, contracting in size as it descends, and

is inserted inferiorly into the rough surface in front of the spine of the tibia, and into the anterior extremity of the *internal* semi-lunar cartilage.

The *posterior crucial ligament* arises *superiorly* from the external surface and anterior part of the internal condyle of the femur, passes downwards, backwards, and outwards, enlarging as it descends, and is inserted *inferiorly* into the rough surface behind the spine of the tibia, and into the posterior extremity of the *external* semi-lunar cartilage. These ligaments differ in every particular origin; insertion, shape, direction, etc.; their use is, besides connecting the femur, tibia, and cartilages, to resist inversion of the foot or eversion of the thigh; when the other ligaments of the joint are cut across, these will be found to become unfolded on turning the foot outwards.

The *ligament of Wrisberg* is an irregular band of fibres, most frequently wanting; when present, it in general stretches from the posterior extremity of the external semi-lunar cartilage to the internal condyle of the femur.

The *two semi-lunar* or *inter-articular* cartilages are oval-shaped flattened bodies, of a fibro-cartilaginous structure, placed between the condyles of the femur and the tibia, but more intimately connected to the latter than the former; they are called *external* and *internal*; each consists of an *anterior* and *posterior extremity* or *cornu*, an *external* and *internal edge*, an upper and lower *surface*.

The *external semi-lunar cartilage* is somewhat circular; it is shorter from before backwards than the internal, but is wider transversely; its *anterior* extremity larger than the posterior, is implanted into the rough surface in *front* of the spine of the

tibia; its *posterior* extremity is inserted into the rough surface *behind* the spine, and has attached to it the posterior crucial ligament; its *outer edge* convex, deeper than that of the internal, corresponds posteriorly to the tendon of the poplitæus muscle which grooves it; and externally to the external inferior articular artery which intervenes between it and the external lateral ligament; its *internal edge* thin, sharp, and concave, is free and covered by the synovial membrane; the external lateral ligament has a very slight attachment to this cartilage.

The *internal semi-lunar cartilage* is oval in shape, and longer than the external; has its *anterior* extremity, smaller than its *posterior*, attached to the same rough surface in front of the spine of the tibia, anterior to the attachment of the external; into it is inserted the inferior extremity of the anterior crucial ligament; its *posterior* extremity is inserted into the rough surface behind the spine, and posterior to the corresponding extremity of the external semi-lunar cartilage; its *outer edge* is firmly connected to the internal lateral ligament, its *internal edge* is free and concave; the *anterior* extremities of both are connected by the transverse ligament; their *upper surfaces* are concave, the *inferior* nearly plane. These cartilages, like the crucial ligaments, differ in almost every particular, as may be collected from the preceding description. Their *use* is to present a deep excavation for the reception of the condyles of the femur, to follow them in the different motions of the joint, to adapt themselves to the different surfaces of the femur in contact with them in flexion and extension, and to lessen the effects of shocks; the *internal* one although more fixed, is more liable to

displacement than the *external*; we may explain this by the greater weight of the joint being thrown on the inner side, in consequence of the oblique direction of the femur, and the greater depth of the internal condyle, and by the fact of its being more fixed preventing it from following the condyle of the femur so completely as the external. Their *structure* is fibro-cartilaginous, the fibres are concentric, or nearly so, and are longer and more manifest externally than internally.

The *synovial membrane* lining the interior of the knee joint, is the most extensive in the human body, and the most liable to disease; we may commence its description at the posterior part of the patella, from this it descends, lining a quantity of fatty substance, formerly called Haversian glands, which separates it from the ligamentum patellæ; on either side of this bone it forms the alar ligaments, and from these is reflected on the mucous ligament to the femur; from the fatty substance it passes backwards on the articular surfaces of the tibia, covers the under surface of the semi-lunar cartilages, winds round their concave margins, covers their superior surfaces, is reflected *laterally* on the inner surfaces of the lateral ligaments closely related to the internal; and externally enveloping the tendon of the poplitæus muscle; from these it ascends on the different surfaces of the femur, extends *anteriorly* as high as the junction of the middle and inferior thirds of this bone, from which it reflects itself on the posterior surface of the tendon of the rectus, which conducts it to the patella from which we set out; *posteriorly* the synovial membrane covers the articular surface of the femur, descends along the crucial ligaments

which it partly invests, the *anterior* not being covered where it is in contact with the posterior, and the *posterior* being uncovered both here and at the back part of the joint; these conduct it down to the upper articular surface of the tibia, where it spreads out as before described; in the centre the synovial membrane passes from the femur along the ligamentum mucosum. It is only by repeated dissection the student will be able to obtain an accurate idea of the reflexions of this synovial membrane.

The *knee joint* belongs to the class *imperfect Angular Ginglymus*. Its motions are *flexion*, *extension*, and *slight lateral motion* in the flexed position. *Flexion* of the knee joint is bending it backwards; it is arrested by the posterior part of the leg striking the back of the thigh—this motion is favoured by the shape of the articular surfaces of the bone, and by the ligaments of the joint being situated chiefly at its posterior part. *Extension* is straightening the limb; this motion is resisted by the ligaments being put on the stretch, and is limited to preserve the poplitæal artery from being violently extended; in these motions the patella changes its relations to the joint; in the *flexed* position it rests on the articular surfaces of the condyles of the femur; in the *extended*, it corresponds to the interval between the two bones. *Slight lateral motion* is enjoyed in the *flexed* position of the joint, as, when one limb is thrown across the other; it is favoured by the ligaments becoming relaxed, and by the round surfaces on the posterior part of the condyles of the femur corresponding to the semi-lunar cartilages; this motion is useful in progression, as we are thus enabled more effectually to turn the

foot outwards; it is altogether wanting in the extended position, because it is then the greatest weight is thrown on the joint, and any lateral motion then would render it insecure.

THE SUPERIOR PERONÆO-TIBIAL ARTICULATION.

This articulation is situated at the *upper, outer,* and *posterior* part of the leg, and is formed by two bones, the *tibia* and *fibula*—the *former*, at its upper and outer part is marked posteriorly by an oval, convex articular surface, directed downwards, backwards, and outwards, which forms this articulation with a corresponding surface, slightly concave on the upper and inner part of the head of the *latter*; they are connected by two ligaments, the *anterior* and *posterior peronæo-tibial*, and a synovial membrane.

The *anterior peronæo-tibial* ligament arises from the anterior part of the head of the fibula, passes upwards and inwards, and is inserted into the anterior surface of the tibia.

The *posterior peronæo-tibial* ligament is situated at the posterior part of the joint, and has a similar origin and insertion to the anterior; it is not so strong as the anterior; the *interior* of the joint is lined by synovial membrane, which is either in close contact with that of the knee joint, or communicates with it along the tendon of the poplitæus muscle; it belongs to the class Arthrosis; its motions are very trifling.

The *Tibia* and *Fibula* are connected in the *centre* of the leg by a strong fibrous structure, termed the *interosseous membrane* or ligament; this, more extensive above than below, fills the interval which exists between the two bones, connects them together, and gives origin to several muscles; on

the inner side its fibres are attached to the external edge of the tibia, they pass downwards and outwards, and are implanted into the sharp spine on the inner edge of the fibula; *superiorly* this membrane is deficient, and leaves a large interval through which the anterior tibial artery, some branches of nerves, and a few fibres of the tibialis posticus muscle pass, *inferiorly* it also leaves a passage, but much smaller, for the anterior branch of the fibular artery; in the *centre* are many foramina for the transmission of vessels; its *anterior surface* is covered by the tibialis anticus, extensor longus digitorum, extensor proprius pollicis, and peronæus tertius muscles, to all of which it affords origin; its *posterior surface* is covered by the tibialis posticus and flexor longus pollicis muscles which also arise from it.

THE INFERIOR PERONÆO TIBIAL ARTICULATION.

This articulation is closely connected with the ankle joint; it is formed by the convex surface on the lower extremity of the fibula being received into a concave surface on the outer edge of the tibia, united by two ligaments, the *anterior* and *posterior peronæo-tibial* ligaments, and a strong *interosseous structure* resembling fibro-cartilage.

The *anterior peronæo-tibial* ligament arises *inferiorly* from the anterior part of the lower extremity of the fibula, passes upwards and inwards, and is implanted into the anterior surface of the tibia; it is triangular in shape, its apex at the fibula, its base at the tibia; it in general projects inferiorly so as to assist in the formation of the ankle joint.

The *posterior peronæo-tibial* ligament is similar to the preceding, but that it is situated *posteriorly*, and is

not so well marked as the anterior. Besides by these ligaments the tibia and fibula are held firmly together by a strong interosseous structure resembling fibro-cartilage, this can be seen only by separating the bones from above downwards, it will be then found to attach itself firmly on either side to the bones above their cartilaginous surface. The lower part of this articulation is lined by cartilage and synovial membrane, which are continuous with those of the ankle joint. This joint may be said to belong to *Amphi-artrosis*; it possesses no motion, as the ankle joint would necessarily be insecure if any motion were permitted between the tibia and fibula; in this respect these bones are much contrasted with the bones of the fore-arm; the former are immoveable, or nearly so; the latter possess considerable motion, evidently showing the different uses for which the upper and lower extremities are intended.

THE ANKLE JOINT.

This articulation is formed by three bones; the *tibia* and *fibula* *superiorly*, the *astragalus* *inferiorly*. The *lower surface* of the *tibia*, where it assists in forming the ankle joint, presents a quadrilateral articular surface, wider *anteriorly* than *posteriorly*, and *externally* than *internally*, concave from before backwards, convex from side to side, which corresponds to the upper surface of the astragalus; this is bounded *internally* by an articular surface on the internal malleolus of an ovoid shape, its long axis directed antero-posteriorly, larger in front than behind, slightly concave for articulation with a corresponding surface on the internal edge of the

astragalus ; *externally* by the external malleolus. The *fibula*, where it forms the articulation, presents, on the inner surface of the external malleolus, a cartilaginous surface of a triangular shape ; its apex below, its base above, convex from above downwards for articulating with a corresponding surface on the outer part of the astragalus. The *astragalus* possesses three articular surfaces for the formation of the ankle joint ; a *superior*, an *external*, and an *internal*, the *superior* articulates with the inferior extremity of the tibia, it is convex from before backwards, concave from side to side, of a quadrilateral shape, narrower posteriorly than anteriorly to admit of lateral motion in the extended position of the joint, and more extensive externally than internally ; its *outer* edge is well defined and projecting ; its inner is rounded off, in consequence of which this surface of the tibia slopes considerably from without inwards, and the greatest weight is thrown on the inner side of the joint, and on the internal lateral ligament, accounting for the great liability to dislocation inwards of the articulation ; the *external* surface is triangular, its apex inferiorly, concave from above downwards, slightly convex from before backwards, to correspond to the articular surface on the external malleolus ; the *internal* is ovoid larger anteriorly than posteriorly, convex, and articulates with the internal malleolus.

THE LIGAMENTS OF THE ANKLE JOINT.

The ligaments of the ankle joint are, the *internal lateral ligament*, the *external lateral ligaments*, the *anterior* and *posterior tibio-tarsal ligaments*, and the *posterior tibio-fibular ligament*.

The *internal lateral* or *deltoid* ligament is situated on the inner side of the joint, covered by the tendons of the *tibialis posticus* and *flexor communis* muscles, the posterior tibial artery, nerve, etc., which must be thrown down in order to expose it; it arises *superiorly* from the inferior edge of the internal malleolus along its whole extent, from this its fibres pass in a radiated manner, the *anterior* pass downwards and forwards, and are inserted into the under surface of the os naviculare, the middle directly downwards to be inserted into the inner part of the astragalus, where they form a fibrous canal through which the tendon of the *flexor longus pollicis* runs, and by means of which this tendon is firmly connected to the astragalus, and into the sustentaculum of the os calcis, the *posterior* fibres pass downwards and backwards, and are inserted also into the astragalus and os calcis; this ligament is broad, strong and expanded, like internal lateral ligaments in general, in order to support the weight of the body thrown obliquely on it, in consequence of the obliquity of the superior articular surface of the astragalus; its *internal* or *inferior* surface is covered by the tendons and vessels already enumerated; its *external* surface corresponds to the articulation; its edges anteriorly and posteriorly are not well defined.

The *external lateral ligaments* are three in number, the *anterior*, *middle*, and *posterior*; they are also called *peronæo-tarsal*, from their attachments.

The *anterior*, *external lateral* or *peronæo-tarsal* ligament, arises from the anterior edge of the external malleolus a little above its apex, passes almost horizontally forwards and inwards, and is inserted into the rough surface on the upper and outer part of the neck of the astragalus.

The *middle external lateral* or *peronæo-tarsal* ligament arises superiorly a little in front of the summit or apex of the external malleolus, passes downwards, backwards and inwards, and is inserted into a tubercle on the outer surface of the os calcis; this is a round fibrous chord, like external lateral ligaments in general, and is much better marked than the others, it has received the name of *perpendicular* ligament, but improperly, as its direction is *oblique* in every position of the joint; the tendons of the peronæus longus and brevis wind round its *outer* surface, its *inner* surface corresponds to the articulation, but is not intimately connected with it.

The *posterior external lateral*, or *peronæo-tarsal* ligament, arises from the inner surface of the external malleolus, passes horizontally backwards and inwards, and is inserted into the rough surface on the posterior part of the astragalus.

The *anterior tibio-tarsal* ligament arises superiorly from the anterior surface of the tibia, directs itself downwards and outwards, and is implanted into the upper part of the neck of the astragalus; it is a weak indistinct ligament, being composed merely of loose cellular structure mixed with fat; its anterior surface is covered by the tibialis anticus, and the extensor tendons, the synovial sheath investing which, frequently communicates with the ankle joint through a deficiency in this ligament.

The *posterior tibio-tarsal* ligament resembles the anterior, except that it is placed at the posterior part of the joint, and is still more indistinct; on cutting through it into the *interior* of the articulation, we bring into view;

The *posterior tibio-fibular* ligament; this ligament

is situated in the interior, and at the posterior part of the ankle joint; it stretches from the outer surface of the internal malleolus transversely across to be implanted into the inner surface of the external malleolus; it is sometimes but badly marked, and then does not reach as far as the fibula; its outer extremity being then attached to the lower edge of the tibia; this ligament might be called the cotyloid ligament of the ankle joint, at least from its resemblance to ligaments of that description in its use, structure, etc., like these, its *use* is to deepen the articular cavity without interfering with the motion of the joint; its *structure* approaches to fibro-cartilage; it is lined by the synovial membrane. The *interior* of the ankle joint is lined by synovial membrane, it invests the cartilaginous surfaces of the bones, the inner surfaces of the ligaments most closely connected with the joint, and passes up a short distance between the tibia and fibula. The ankle joint belongs to the class of *Angular Ginglymus* (imperfect); its motions are *flexion*, *extension*, and *slight lateral motion* in the extended position of the foot. *Flexion* of the ankle joint is bending it forwards, that is, raising the dorsum of the foot towards the anterior part of the leg, and depressing the os calcis; it is performed by the *extensor* muscles of the *toes*, and the tibialis anticus and peronæus tertius muscles; it is limited by the inferior edge of the tibia approaching the neck of the astragalus, and by the tension of the ligaments and tendons at the posterior part of the joint—in this position of the articulation, necessarily the most secure, the foot forms a right angle with the leg, the principal ligaments are put upon the stretch, and the bones completely interlock with one

another, so that lateral motion is entirely prevented. *Extension* is the reverse of flexion ; in it the toes are pointed towards the ground, the os calcis is elevated, and the foot forms with the leg an acute angle posteriorly, an obtuse one anteriorly ; it is much more extensive than flexion, in consequence of the excavation behind the articulation not interfering with it ; it is sometimes carried to such an extent as that the foot and leg are on the same line as is exemplified by some of our modern dancers ; in this position slight lateral motion is enjoyed, because then the narrow posterior part of the astragalus corresponds to the widest interval between the tibia and fibula, and the ligaments are partially relaxed ; this motion is permitted in this position of the joint, but not in the flexed, for obvious reasons ; it is when the joint is *flexed* that the weight of the body is thrown on the foot, lateral motion would then be dangerous ; but when the joint is *extended* the foot is in general raised from the ground for the purpose of progression, lateral motion now becomes useful ; by it we are enabled to evert the toes, and, as it were, to throw round the foot, describing with its anterior extremity a part of a circle, and then place it directly on the ground. The student should not confound the lateral motion enjoyed by the ankle joint with that possessed by the articulations of the foot, as he is likely to do ; the latter enjoy a good deal of lateral motion, particularly that between the astragalus and navicular bone ; the former, but little. The ankle joint is more indebted for its security to the numerous tendons which surround it, than to its ligaments or bones.

THE ARTICULATIONS OF THE FOOT.

The articulations of the foot may be classed into those of the *Tarsus*, *Metatarsus*, and *Phalanges*.

THE ARTICULATIONS OF THE TARSUS.

The *articulations and bones of the Tarsus* are united by numerous ligaments, named from the bones to which they are attached, and situated chiefly on the dorsum, and in the sole of the foot; they are hence divided into the dorsal and plantar ligaments; there are but few of them of such importance as to require a very detailed description; the principal are the *calcaneo-navicular* ligament and the *calcaneo-cuboid* ligament, or *ligamentum longum*, both plantar ligaments. The dorsal ligaments are much weaker than the plantar, and are as follows:

The *astragalus* is connected *anteriorly* with the *os naviculare* by a band of fibres, stretching along the upper surfaces of the bones, *externally* to the *os calcis* by a ligament which arises from the anterior surface of the neck of the *astragalus*, and is attached to the anterior extremity of the *os calcis*.

The *os calcis* is connected *anteriorly* to the *os cuboides*, internally to the *os naviculare*, by fibrous bands, passing between the bones, and also internally to the *astragalus* by the ligament just described.

The *scaphoid* or *navicular* bone is connected *anteriorly* to the three cuneiform bones by three bands of fibres passing from its upper surface to the corresponding surfaces, and diverging as they pass forwards; *externally* to the *os cuboides* by a few

irregular superficial fibres ; *posteriorly* to the astragalus and os calcis by the ligaments just described.

The *three cuneiform bones* are connected *anteriorly* to the three internal metatarsal bones, *externally* to the cuboid bone by fibrous bands, passing from one to the other, and *posteriorly* to the navicular bone by ligamentous fibres already mentioned.

The *os cuboides* is connected *anteriorly* to the two outer metatarsal bones by irregular fibres, stretching between them ; *internally* to the cuneiform bones ; and *posteriorly* to the os calcis, as already described.

The *plantar* ligaments connecting the tarsal bones are much stronger, and more numerous than the dorsal ; there are only two of them, however, deserving of distinct consideration : these are the *calcaneo-navicular*, and the *calcaneo-cuboid* ligaments.

The *calcaneo-navicular ligament* is situated at the inner part of the foot, where it is concealed by the tendon of the tibialis posticus muscle, which lies immediately beneath it, and must therefore be removed to expose it ; it is attached *posteriorly* to the anterior part of the sustentaculum of the os calcis, passes forwards and inwards, and is inserted *anteriorly* into the under surface of the navicular bone ; the *inferior* surface of this ligament is covered by the tibialis posticus tendon ; its *superior* is lined by synovial membrane, where it supports the head of the astragalus without being attached to it ; its *structure* is fibro-cartilaginous, or even sometimes bony, particularly in its centre, where it lies between the tendon inferiorly and the bone superiorly ; its principal use is to support the head of the astragalus for which purpose it possesses much elasticity.

The *calcaneo-cuboid ligament* or *ligamentum longum*

is the longest and most powerful of the ligaments of the foot; it arises from the posterior and inferior part of the os calcis, passes almost directly forwards, expands, and is inserted first into the tubercle on the under surface of the cuboid bone, then assists in forming the tendinous sheath for the peronæus longus tendon, and finally is implanted into the base of the metatarsal bones spreading out and mixing its fibres with the ligaments which connect these together; it lies deep in the sole of the foot and cannot be seen until all the muscles are removed.

Besides these ligaments, the tarsal bones are connected together and to the metatarsal bones by irregular bands of ligamentary fibres much stronger than the dorsal ligaments; they need not be particularly described: in fact, where the tarsal bones approximate, they are connected by fibrous bands, and may be named, by the student himself, from the bones into which they are implanted: between the bones will be met with, occasionally, interosseous ligaments of a strong fibrous nature: the most remarkable of these are, one which is lodged in the deep groove in the under surface of the astragalus, connecting it to the os calcis, into a distinct groove in which it is inserted; and another between the navicular and cuboid bones. After dissecting these ligaments, the student may proceed to cut into, and examine, the tarsal articulations, they are as follows:

The *Calcaneo-astragalean* articulations: these are two in number, a *posterior* and *anterior*, and are formed between the under surface of the astragalus and the upper of the os calcis. The *posterior* is external to, and larger than, the other; this forms an arthrodial articulation, the convexity on the os calcis;

the concavity on the under surface of the astragalus ; it is elongated in an oblique direction forwards and outwards, and is lined by a distinct synovial sac. The *anterior* smaller and internal to this, forms a planiform articulation, the surface on the os calcis being a little concave, this is also lined by synovial membrane, sometimes continuous with the astragaleo-navicular articulation.

Calcaneo-cuboid articulation ; this is formed by the anterior extremity of the os calcis and the posterior of the cuboid bone ; it is an arthrodial joint, the articular surface on the os calcis is concave downwards and outwards, convex transversely, and directed forwards and outwards, that on the cuboid bone is the reverse ; they are lined by synovial membrane.

The *astragaleo-navicular* articulation, is the most important in the foot, it is formed by the *anterior* convex surface or head of the astragalus being received into the posterior concave surface of the navicular bone ; it is a ball and socket or arthrodial articulation, and resembles the shoulder joint much ; it is elongated obliquely downwards and inwards : the articular surface on the astragalus looks forwards and inwards, is prolonged inferiorly into the articular surface which rests on the calcaneo-navicular ligament, and is much larger than the cavity which receives it ; the articular surface or socket for the reception of this, is on the *posterior* part of the navicular bone ; it is of an ovoid shape, the larger extremity turned upwards and outwards, the smaller downwards and inwards, it resembles the glenoid cavity of the scapula ; this is the most moveable articulation in the foot as may be inferred from the nature of the articular surfaces of the bones, it enjoys almost every motion, though in a slight

degree, and is lined by a distinct synovial sac, it is through these two latter articulations that Chopart's amputation of the foot is performed.

Scaphoido or naviculo-cuneiform articulations—these are three in number, and are formed between the anterior surface of the scaphoid or navicular bone, and the posterior surfaces of the cuneiform bones: they form arthrodial articulations, the convexity on the navicular bone, and are lined by synovial membrane, which passes in between the cuneiform bones. The navicular bone sometimes articulates with the cuboid, when it does they are encrusted with cartilage and lined by synovial membrane.

The *Inter cuneiform articulations* are formed between the cuneiform bones; they are all nearly plane surfaces lined by synovial membrane.

The Cuneo cuboid articulation is formed between the outer surface of the external cuneiform bone, and the inner of the cuboid; they are nearly plane surfaces, and are lined by synovial membrane.

The *Tarso metatarsal articulations*, are formed between the anterior extremity of the tarsus and the posterior of the metatarsus, and are as follows: the *first metatarsal bone* is supported by the internal cuneiform; the *second* by the three cuneiform bones being received into an excavation formed by them posteriorly; the *third* by the external cuneiform bone; the *fourth* and *fifth* by the cuboid bone; they are all nearly plane surfaces, except that between the internal cuneiform and the *first* metatarsal bones, (which form a ball and socket, or arthrodial joint,) and are lined by synovial membrane. It is in this line of articulation, that Hey's amputation of the foot is performed; the student would do well, therefore, to

examine it attentively—commencing *externally* at the projecting point of the fifth metatarsal bone, it runs forwards and inwards, and presents no obstacle to the knife until we arrive at the base of the second metatarsal bone, it then passes *backwards* to the extent of about four lines, then transversely *inwards* for about six lines, then directly forwards about eight lines, and finally inwards, and a little backwards, between the internal cuneiform and the first metatarsal bones.

THE METATARSAL ARTICULATIONS.

The *metatarsal bones* articulate posteriorly with the tarsus as just described, they also possess nearly plane articular surfaces where they are in contact with each other *posteriorly*, lined by a synovial membrane which communicates with that lining the tarso-metatarsal articulations; *anteriorly* they articulate with the first phalanges where they form an *arthrodial* joint; the convex surface on the extremity of the metatarsal bone elongated from before backwards and extending further towards the sole than the dorsum of the foot; the *concavity* on the extremity of the first phalanges smaller, and of an ovoid shape, the smaller extremity being turned upwards; they are connected by lateral ligaments on each side placed near the sole of the foot to admit of flexion, and by the tendinous expansion on their dorsal and plantar surfaces derived from the extensor, lumbricales, interossei and flexor tendons; they possess the motions of *flexion*, *extension*, *abduction*, *adduction* and *circumduction*, but no *rotation*, as this is prevented by the existence of lateral ligaments; in *flexion* they are bent towards

the sole of the foot; this motion can be carried to a great extent; in *extension* they are elevated towards the dorsum of the foot, it is more limited; the other motions need not a particular description.

THE PHALANGEAL ARTICULATIONS.

The first *phalanges* articulate *posteriorly* with the metatarsal bones as just described; *anteriorly* with the second phalanges; the articular surface on the first phalanges is convex from above downwards, concave transversely, resembling the condyles of the femur; that on the second phalanx is the reverse; they are both elongated transversely, and are connected in a manner similar to the metatarso-phalangeal articulations; they form a *ginglymoid* articulation, and possess only flexion and extension.

The *second phalanges* articulate with the *third* or last, in a precisely similar manner; the articular surfaces are much smaller; the great toe has but two articulations.

The Student may now remark, that in the structures he has just examined, every thing conspires to render the foot best adapted to the purposes for which it was originally intended, that is, to support the whole weight of the human body, to enjoy a considerable degree of motion, and possess that elasticity so essential in preventing the delicate structure of the body from being injured in the different pursuits of life, and even under some circumstances to act as a substitute for the hand; for this purpose Nature seems to have adopted the most perfect description of architecture (as we may be allowed to say) in its construction, that is, the

arch, she has arched it into two different directions, from *behind forwards*, and *transversely*; the *antero-posterior* arch is much longer, and more extensive than the transverse; its points of support are *posteriorly* at the tuberosity of the os calcis, *anteriorly* at the metatarso-phalangeal articulations; between these two points the foot seems to be as it were completely suspended, and especially towards its inner side where the arch is best marked, and here we may remark the beauty of this seemingly trifling circumstance; it is the *outer edge* of the foot which comes in contact with the ground; here it is formed of but two bones; its elasticity therefore is less, but its security is greater, and the loss it experiences in its elasticity by this piece of mechanism is counterbalanced by the greater elasticity of the *inner* edge, formed by a numerous assemblage of bones generally of a wedge shape, and so articulated that any force applied from above will rather tend to interlock the bones more perfectly; and if the Student will recall to mind the mechanism of the ankle, knee, and hip joints, he will see that this is in perfect accordance with the structure of these articulations; in them the weight is thrown rather on the internal ligaments than directly on the bones, and here in the foot the same object is accomplished by the oblique direction of the upper surface of the astragalus, and the position of this bone in the tarsus, the weight of the body being thrown not directly on the os calcis, but rather towards the inner part of the foot which enjoys the greatest share of elasticity, and on that part, which, if it yield, may receive the support of the opposite extremity; the same mechanism is observed in the posterior

and anterior parts of the tarsus ; the former, that is, the posterior extremity, is composed of but two bones, the latter of several, here we see the buttress of the arch presents strength and security, but the anterior part elasticity ; in fact every bone of the tarsus is arranged so as to perform its part individually in it ; but now let us pass further forwards, towards the metatarsus, and here we find that the foot expands considerably, and especially at the metatarso-phalangeal articulations ; the mechanism of this is obvious ; the basis of support is thereby increased, and not only this, but in consequence of the increasing breadth of the foot anteriorly, it is disposed here rather to spread out in the lateral direction than antero-posteriorly, as is the case in the tarsus, but here the foot is arched *transversely*, and the arch being secured at its tarsal end by the wedge shape of the bones, by the ligaments, tendons, etc., the breadth anteriorly alone increases, and consequently, this part spreading beyond the others, the metatarsal bones have a tendency to be forced backwards and inwards towards the centre of the foot, and thus support and preserve in their place the tarsal bones ; the advantage of the mechanism of the foot is evidenced in stage performers, in leaping, walking, etc. ; its loss is experienced by those who have lost either a part or the whole of the foot, as in Hey's, and Chopart's operations, and in amputation of the leg ; nay, even in those in whom, from disease or accident, the bones are consolidated, or their articulations rendered useless ; but it is not in its dried state merely that the foot must be examined to understand its advantages, nor even with the ligaments attached, but when the other structures

are connected to it, the muscles, tendons, etc.; all these assist in perfecting the foot; here are structures connecting the bones together, possessed of contractility and elasticity; the former in themselves, the latter by means of the muscles which they terminate, and by means of these properties together with their oblique direction in the sole of the foot, answering even better than ligaments. The *arched* state of the foot is also useful in giving lodgement to its principal vessels, nerves, etc., which run along its under part. Mr. Abernethy compared the foot to a tripod, the three points of support being posteriorly at the os calcis; anteriorly at the ball of the great toe, and externally at the projecting base of the fifth metatarsal bone; the last, however, but seldom touches the ground.

CHAP. IV.

THE UPPER EXTREMITIES.

The *upper extremities* are two in number, placed one on each side at the upper, and rather posterior part of the trunk, connected to the superior extremity of the thorax; they may be divided each into the *shoulder, arm, fore-arm, and hand*.

SECTION I.

THE BONES OF THE UPPER EXTREMITIES

Consist of the *clavicle* and the *scapula*, which are those of the *shoulder*, the *humerus* or bone of the arm, the *radius* and *ulna*, which constitute the *fore-arm*,

and the bones of the hand which are divided into those of the *carpus*, *metacarpus*, and *phalanges*; the carpal bones being eight in number, the *os scaphoides* or *naviculare*, *os lunare*, *os cuneiforme* or *pyramidale*, *os pisiforme*, *os trapezium*, *os trapezoides*, *os magnum*, and *os unciforme*; the metacarpal five in number, one for each finger; the *phalanges* being like those of the foot, fourteen in number, three for every finger except the thumb which has but two.

BONES OF THE SHOULDER.

The *clavicle* or *collar bone*, is the long bone which is situated at the upper and anterior part of the chest, extending from the sternum to the scapula; it is divided into its *sternal* and *scapular extremities*, and its *body* or *shaft*.

The *sternal* or *internal*, or *anterior* extremity of the clavicle is thick, strong, and triangular, the apex at its posterior inferior angle, it is marked by an articular surface, convex from above downwards, concave from behind forwards, directed downwards, forwards and inwards, for articulation with the sternum; its edges, extensive anteriorly and superiorly, pointed inferiorly, give attachment to ligaments; from this the *body* of the clavicle passes upwards, backwards and outwards, covering the first rib and coracoid process of the scapula, it is curved on itself so as to resemble an italic S, having its convexity first turned *forwards* and then *backwards*; near the *sternum* it is triangular in shape, and gives attachment by its anterior convex surface, to the clavicular position of the pectoralis major muscle, by its posterior concave portion to the sterno-cleido mastoid; its superior surface is smooth,

rounded, and subcutaneous; its inferior presents a rough surface for the insertion of the rhomboid ligament, in the *centre* the clavicle becomes smooth, circular, and contracted, and gives origin to no muscular fibres; it is here the two curves, of which the bone is composed, meet, and that fracture is so frequent; its under surface is rough for the attachment of the costo-clavicular ligament; towards its *scapular* or *acromial* extremity, the clavicle becomes flattened superiorly and inferiorly, and gives attachment by its *anterior* concave edge to the deltoid muscle, by its *posterior* convex to the trapezius, superiorly it is rough and subcutaneous, inferiorly also rough and marked by a groove for the insertion of the subclavian muscle; in this is the foramen for the nutritious artery of the bone; external to this is a rough surface for the insertion of the conoid and trapezoid ligaments. The *acromial* end of the clavicle becomes thick and rounded off; its superior and inferior surfaces are rough for the attachment of ligaments connecting it to the acromion process, it is marked at its outer edge by an articular surface oblong from before backwards, directed downwards and outwards, cut off obliquely downwards and inwards, so that it may rest on this process; the clavicle articulates with only two bones, the sternum and scapula.

The *use* of the clavicle is to keep back the shoulder and connect the scapula to the trunk, being their only bony connexion; it also gives attachment to the muscles and ligaments enumerated, and protects the subclavian artery and vein, and brachial plexus of nerves from injury: its vascular supply and structure are the same as all long bones, with the exception that its medullary canal is not well marked.

In the female the clavicle is longer and less curved than in the male, it is also much smaller and more circular in shape. In the *Fœtus* it is the first bone developed, appearing so early as the sixth week; it has three points of ossification, one for the body and one for each extremity; that for the body appears much sooner than the others.

To place the clavicle in situ, its sternal extremity must be anterior, internal, and inferior to its acromial; it must, therefore, slope upwards, backwards and outwards.

The *Scapula* is an irregular-shaped bone placed at the *posterior* and *upper* part of the trunk to which it is connected by numerous muscles and the clavicle, extending from the *first* to the *seventh* rib; it is of a triangular shape, and is divided into *two surfaces*, an *anterior* and *posterior*, three edges or borders, a *superior*, a *posterior* or *vertebral*, and an *inferior* or *axillary*, and *three angles*; a *posterior*, an *inferior*, and an *anterior* angle.

The *anterior surface* of the scapula, called also, the sub-scapular fossa, is directed forwards and inwards towards the thorax; it is excavated considerably, in order to accommodate the convexity of the ribs on which it rests, and to give lodgement to the sub-scapular muscle; it is marked by three, four, or five oblique ridges, which run downwards and backwards, and are more evident near the posterior than the anterior edge for the tendinous origins of this muscle; between these ridges the bone is thin and transparent, they serve to strengthen the scapula; at the posterior part of the fossa near the superior and inferior angles, it is smooth for the insertion of the serratus magnus muscle.

The *posterior surface* or *dorsum* of the scapula is irregularly convex, directed backwards and outwards, and is divided unequally into two portions, a *superior* and *inferior*, by an irregular ridge of bone, termed the spine: the *superior* part above the spine is called the *supra spinatus fossa*, it is much smaller than the inferior, broad and shallow posteriorly, narrow and deep anteriorly; is irregularly concave and gives lodgement to the supra spinatus muscle: the *inferior* part called the *infra spinatus fossa*, is much larger than the superior; it is convex superiorly, concave inferiorly, and affords origin in almost its whole extent to the infra spinatus muscle; at its lower part, near the axillary border of the scapula, it becomes thick and elevated, and forms a somewhat flat surface, marked by two ridges; this is broad and quadrilateral inferiorly where it gives origin to the teres major muscle, narrow and triangular superiorly, where the teres minor arises, the ridges give attachment to tendinous aponeuroses connected with these muscles. The *spine* of the scapula is the remarkable ridge already described as separating the supra and infra spinatus fossæ; it is triangular in shape, and is situated near the upper edge of the scapula; it commences near the posterior edge of the scapula, by a triangular smooth surface, over which passes the tendon of the trapezius muscle, and from which it is separated by a bursa; from this the spine ascends outwards and forwards, forming an irregular line inferiorly, which gives origin to the deltoid muscle, a nearly straight line, superiorly, for the insertion of the trapezius, and terminates in the *acromion process*; this is a remarkable projection of bone, flattened superiorly and inferiorly, which overhangs the shoulder joint;

its upper surface is rough and subcutaneous, and slopes downwards and backwards; its inferior surface is smooth and slightly concave; its internal edge concave, gives insertion to the trapezius muscle posteriorly, and anteriorly is marked by an oblong articular surface cut off obliquely downwards and inwards, which articulates with, and supports, the clavicle; in front of this it is rough for the insertion of the coraco-acromial ligament, the external edge is convex, and gives origin to the deltoid muscle. The superior surface of the spine is concave, and forms part of the supra spinatus fossa; the inferior is concave posteriorly, convex anteriorly, and forms part of the infra spinatus fossa; they are turned in a contrary direction to the surfaces of the acromion process; in general two or three foramina for the passage of vessels may be observed at the root of the spine.

The *superior border* of the scapula, thin and sharp, is the shortest of the three, it slopes downwards and forwards; at the junction of its anterior and middle thirds is a notch converted into a foramen by the posterior proper ligament, which gives transmission to the supra scapular nerve, the artery of the same name in general passes above this ligament; the edge gives origin to the supra spinatus posteriorly, subscapularis anteriorly, and the omo-hyoid muscle superiorly; in front of the notch arises a long irregular eminence termed the *coracoid process*; this occupies at its root or origin, the remaining part of this edge as far as about a line from the glenoid cavity; from this it first ascends forwards and outwards, and then turning more forwards, descends a little, and terminates in a point or beak; its upper surface is

rough, and gives attachment posteriorly to the conoid and trapezoid ligaments, and a few fibres of the omohyoid muscle ; its under surface is smooth and concave ; its internal edge gives insertion to the pectoralis minor ; its external to the coraco acromial ligament ; from its point arise the coraco brachialis muscle and short head of the biceps, it serves as a protection to the shoulder joint which it overhangs towards its internal side. The *posterior* or *vertebral border*, or *base* of the scapula is turned backwards and inwards towards the spine, to which it is nearer superiorly than inferiorly ; it is the longest, is at first directed a little backwards, then forms an angle where the spine arises, and then passes forwards ; it gives attachment posteriorly to the supra and infra spinatus muscles, anteriorly to the serratus magnus, and between these to the rhomboid muscles—the *inferior* or *axillary border* is shorter, but stronger than the preceding ; it extends forwards and upwards from the inferior angle to the glenoid cavity, from its anterior superior part, close to the glenoid cavity, arises the long head of the triceps ; from this to the inferior angle it gives origin posteriorly to the teres minor, anteriorly to the subscapularis muscle ; inferiorly it terminates by becoming flat and thin, and gives origin posteriorly to the teres major muscles, and a few fibres occasionally of the latissimus dorsi. The *posterior angle* of the scapula is that formed by the junction of the superior and posterior edges ; it is rounded off, gives insertion to the levator anguli scapulæ ; the *inferior angle* is formed by the junction of the posterior and axillary borders ; it is more acute than the posterior, and is covered by the origin of the teres major muscle and the latissimus dorsi.

the *anterior angle* is formed by the junction of the superior and axillary borders, it is truncated and presents a superficial concave articular surface, ovoid in shape its long axis directed vertically, large inferiorly, narrow and pointed superiorly, for articulating with the humerus and forming the shoulder joint; it is termed the *glenoid cavity*, this looks upwards, forwards, and outwards, is surrounded by a ridge of bone, and by the cotyloid ligament, and is supported by the *anatomical neck*, which is that portion situated behind the edge of the cavity, and in front of the root of the coracoid process; it gives origin to the capsular ligament of the shoulder joint, and is called anatomical to distinguish it from the surgical neck where fracture sometimes occurs; this is posterior to the root of the coracoid process, and passes through the notch in the superior border. The scapula is supplied by vessels which enter it principally near its processes and edges; its structure is compact where it is thin, but it contains spongy tissue between two layers of compact tissue where it is thick, as in the processes, etc.; its ossification takes place from several points which commence in the centre of the bone, in the coracoid and acromion processes, the spine, the posterior border, the glenoid cavity and the inferior angle: in the fœtus it possesses epiphyses along its posterior border and spine; in the old subject it becomes thin, light and diaphanous; it articulates with but two bones, the clavicle and humerus; its mode of connexion with the trunk is termed *sysarcosis*. To place it in situ, it should extend from the lower border of the first to the seventh rib, the point of the coracoid process should be directed forwards and correspond to the first intercostal

space; the posterior or vertical border should be separated farther from the spine inferiorly than superiorly, and the glenoid cavity should look forwards, upwards and outwards.

THE HUMERUS.

The *Humerus* or *os-humeri*, is the longest and largest bone of the upper extremity, and is the only bone in the arm; it extends from the shoulder to the elbow, belongs to the class of long bones, and may be divided into its *upper extremity* or *head*, *its neck*, *body* or *shaft*, and *lower extremity*. The *head* of the humerus is the most expanded portion of the bone; it is a round hemispherical convex eminence, encrusted with cartilage, which is thicker in the centre than the circumference, and extends farther outwards on its superior than its inferior part; it forms with the glenoid cavity of the scapula, the shoulder joint, and looks upwards, backwards and inwards; it is connected to the shaft of the bone by the *anatomical neck* of the humerus, a rough irregular depression immediately external to the head, narrow superiorly, wide and expanded inferiorly, which gives insertion to the capsular ligament of the joint; it is placed on the posterior and inner part of the bone, the shaft of which it joins so as to form an obtuse angle inferiorly; external and anterior to the neck we observe two eminences, a larger and smaller, separated by a groove; they are called the *tuberosities* of the humerus, the larger being the *external* or *posterior*; the smaller, the *internal* or *anterior*: the former of these is placed on the outer side of the bone, is round and marked by three flat surfaces: a superior, middle and inferior, for the attachments

respectively of the supra spinatus, infra spinatus and teres minor muscles ; the latter is situated towards the inner side, is sharp and more projecting, and gives attachment to but one muscle, the sub scapularis ; these tuberosities may be compared to the trochanters of the femur ; the groove which separates them is called the *bicipital groove*, because in it is lodged the long tendon of the biceps ; it commences inferiorly towards the inner edge of the bone, and ascends a little outwards, becoming much deeper superiorly ; it is bounded on either side by two ridges, termed the *inner* or *posterior*, the *outer* or *anterior* edges of the bicipital groove ; into the former is implanted the tendons of the latissimus dorsi, and teres major ; into the latter, the better marked of the two, is inserted the pectoralis major muscle ; these edges separate superiorly and terminate in the tuberosities ; immediately below the tuberosities the humerus becomes contracted, and terminates in the shaft of the bone ; this extends from the tuberosities to the inferior extremity ; its upper third is round and strong, and has received the name of the *surgical neck*, as it is here that fracture so frequently takes place, to distinguish it from the anatomical neck already alluded to ; its middle third is irregularly twisted, and of a triangular shape ; its inferior becomes expanded and flattened anteriorly and posteriorly. The *posterior surface* of the humerus is smooth, concave superiorly, and directed a little inwards, convex inferiorly, and looks outwards ; it gives origin to the triceps muscle by which it is covered ; its *external surface* is smooth and concave superiorly, and is covered by the deltoid muscle ; but at the junction of the upper and middle third presents an extensive rough surface for the insertion

of this muscle ; below this it becomes smooth again, and is marked by a superficial groove which commences at the posterior, and terminates at the anterior surface of the bone, and in which the musculospiral nerve and artery pass ; the *internal surface* of the humerus is somewhat flattened, it presents superiorly the termination of the bicipital groove ; below this, and about the centre of the bone is the nutritious foramen directed downwards and outwards, surrounded by a rough surface, into which is implanted the corâco-brachialis muscle ; inferiorly it is convex, becomes anterior, and is covered by the brachialis anticus muscle. The surfaces of the humerus are separated by *three ridges*, an *anterior*, *internal*, and *external* ; the *anterior* commences superiorly from the outer edge of the bicipital groove, becomes more prominent, is marked by the rough surface for the deltoid muscle, and terminates inferiorly by being gradually lost on the anterior surface of the bone spreading out towards each condyle ; the *internal ridge* occupies only the two inferior thirds, it commences gradually above, and terminates inferiorly in a sharp projecting ridge, which leads to the inner condyle ; superiorly it gives attachment to the triceps muscle, in the centre to the coraco-brachialis, and inferiorly to the brachialis anticus in front, the triceps behind, and the internal inter muscular septum between these ; the *external ridge* occupies little more than the inferior half of the bone ; it commences superiorly on the posterior surface of the bone where it gives attachment to the triceps muscle, winds downwards, forwards and outwards, becomes sharp and projecting inferiorly, gives origin to the brachialis anticus, the supinator

longus, and the extensor carpi radialis longus muscles, and to the external inter-muscular septum, and terminates inferiorly at the external condyle. The *inferior extremity* of the humerus is turned forwards and inwards, becomes elongated transversely, flattened anteriorly and posteriorly, and terminates in forming the articular surfaces for the reception of the radius and ulna; its anterior surface, which also looks inwards, is convex, and is marked inferiorly by the *anterior humeral fossa* which receives the coronoid process of the ulna *in flexion* of the elbow joint; the posterior surface turned outwards, is more extensive, concave, and marked by a deeper depression, the *posterior humeral fossa* which receives the olecranon in extreme extension of the joint; *externally* we observe a process, in which terminates the external ridge of the bone, termed the *external condyle*; this is placed on a plane, anterior to the internal condyle, and gives origin to the external lateral ligament of the elbow, and most of the extensors and supinators of the fore-arm; as we pass from this *internally*, we meet with the *capitulum*, or *lesser head* of the humerus, a rounded, convex, articular eminence turned forwards, which is received into the cup-like cavity of the radius, and is bounded anteriorly by a depression for receiving the radius in flexion of the joint; internal to this is a depression for receiving the projecting lip of the same bone; still more internally, and separated from it by a slight projection of the bone is the *trochlea*, a large articular surface concave from side to side, convex from before backwards, directed forwards and inwards, bounded in front and behind by the anterior and posterior humeral fosse, and articulated with the

great sigmoid cavity of the ulna; this is bounded internally by a prominent ridge of bone which descends considerably below the rest of the humerus, and is termed the *epitrochlea*; internal to this is a rough depression, and most internally the *internal condyle*, a sharp triangular process of bone, directed backwards and inwards, and placed on a plane posterior and superior to the external, and much more projecting than it; this gives attachment to the internal lateral ligament, and most of the flexor and pronator muscles; the lower extremity of the bone is turned forwards and inwards, so that the fore-arm may be thrown across the chest in flexion of the elbow joint. The humerus is supplied with vessels, etc., and presents the same structure as all long bones; it is developed by several points of ossification, one each for the head, tuberosities, body, the condyles, the trochlea, and the lesser head; it articulates with three bones: the scapula superiorly, the radius and ulna inferiorly; when placed in situ the head is directed upwards, backwards, and inwards; the bicipital groove directly forwards; the external condyle forwards and outwards; the internal backwards and inwards.

THE BONES OF THE FORE-ARM.

The bones of the fore-arm are the *Radius* and *Ulna*.

The *Radius* is situated on the outer and anterior part of the fore-arm, between the humerus above, and the carpus below; it is shorter than the ulna, but extends beyond it inferiorly to form the wrist joint; it is small and rounded superiorly, triangular, and directed outwards in the centre; expands

considerably, is flattened, and quadrilateral inferiorly ; it may be divided into the *head*, *neck*, *tubercle*, *body*, and *lower extremity* ; the *head* of the radius occupies its highest part ; it is circular and concave, encrusted with cartilage, and forms a cup-like cavity to receive the lesser head of the humerus ; it is surrounded by a projecting lip of bone covered also by cartilage, expanded internally where it corresponds to the lesser sigmoid cavity of the ulna, more narrow and prominent externally where it is surrounded by the annular or orbicular ligament ; beneath this is the *neck* of the radius, small, circular, and contracted ; about an inch in length and encircled partially by the annular ligament, it descends forwards and inwards ; beneath it, and on the internal anterior part of the radius, is the *tubercle*, a remarkable prominence, rough posteriorly where it gives insertion to the tendon of the biceps ; smooth anteriorly where it is lined by a bursa, which separates it from this tendon ; the *body* of the radius descends from this ; it is triangular, and presents *three surfaces*, an *anterior*, *posterior*, and *external*, separated by as many ridges ; the *anterior surface* flattened, concave nearly throughout, narrow superiorly, broad and expanded inferiorly, gives attachment in its three superior fourths to the flexor sublimis and flexor longus pollicis muscles ; in its inferior fourth to the pronator quadratus muscle ; at the junction of its upper and middle third, and to its outer side, it presents the foramen for the nutritious artery, directed upwards ; the *external surface* is convex, rounded, and arched outwards ; it gives attachment superiorly to the supinator brevis muscle ; beneath this, and nearly in the centre of the bone, it is rough

for the insertion of the pronator teres tendon ; beneath this it is covered by the tendons of the supinator longus and radial extensors ; the *posterior surface* is convex superiorly, and gives insertion to the supinator brevis muscle ; concave in the centre, and gives origin to the extensors of the thumb, convex inferiorly where it is covered by the extensor tendons.

Of the *three ridges* the *internal* is the best marked ; it gives attachment to the interosseous ligament ; the anterior and posterior are indistinct, and give origin to a few of the muscles just mentioned.

The *inferior or carpal extremity* of the radius is the largest part of the bone ; it is quadrilateral, flattened, and concave *anteriorly* for the insertion of the pronator quadratus muscle, convex and irregular *posteriorly*, and marked with *three grooves*, an *external*, *middle*, and *internal* ; of these, the middle is the deepest and narrowest, is directed downwards and outwards, and lodges the extensor secundi internodii pollicis tendon ; the *internal* is wider, and gives lodgement to the tendons of the extensor communis and indicator muscles ; the *external* is the widest, but shallowest of the three, is sometimes divided into two, and gives passage to the tendons of the extensor carpi radialis longus and brevis muscles ; on its external surface it presents a triangular, rough surface for the insertion of the supinator longus tendon, and terminates inferiorly in the *styloid process* to which is attached the external lateral ligament of the wrist joint ; this is sometimes grooved posteriorly for the passage of the tendons of the extensor ossis metacarpi pollicis and primi internodii ; *internally* is a smooth articulating surface, concave, which receives the outer edge of the ulna ; *inferiorly* the radius

presents a concave articular surface somewhat triangular, the base internally, divided into two surfaces, an external and an internal, by a ridge running from before backwards; of these the external surface is large and triangular, and connected to the scaphoid bone; the internal is quadrilateral and articulates with the os lunare; the ridge is received between these bones; into its inner edge is implanted the *triangular cartilage* of the wrist joint which here separates this articular surface from that for the ulna; the anterior and posterior edges of these surfaces give attachment to the anterior and posterior carpal ligaments.

The radius belongs to the class of long bones; its structure and supply of vessels are similar, therefore, to those in general; it is developed from three points of ossification—one for each extremity, and one for the body; it articulates with four bones, the humerus above, the ulna above and below, the scaphoid and lunar bones inferiorly; when placed *in situ* its smaller extremity is turned upwards; its larger downwards; its tubercle inwards, and a little forwards; its convex arched surface outwards, and the grooves on its inferior extremity backwards.

The *Ulna* is situated in the internal and posterior part of the fore-arm, large and irregular above; it gradually diminishes as it passes downwards; is triangular in the centre, exceedingly small and circular inferiorly; it is longer than the radius, and passes much higher up on the arm; it may be divided into a *superior* and *inferior extremity*, and a *body* or *shaft*; the *superior extremity* of the ulna is the large irregular portion which articulates with the humerus; on it are two large processes, a posterior and an

anterior ; the posterior process called the *olecranon* is much longer and broader than the anterior ; it ascends almost directly upwards from the shaft of the bone, being the highest part of the ulna ; superiorly it gives insertion to the triceps muscle ; posteriorly it is marked by a smooth, elongated, triangular surface, subcutaneous, and covered by a bursa mucosa ; internally it gives attachment to the internal lateral ligament of the elbow joint, and the flexor carpi ulnaris muscle ; anteriorly it is covered by cartilage, and forms part of the *great sigmoid cavity* ; the *anterior* or *coronoid* process projects from the anterior surface of the bone in front of, and beneath, the olecranon ; it is pointed and triangular, and turned a little upwards ; it gives insertion to the brachialis anticus muscle inferiorly ; superiorly it is concave and covered with cartilage ; internally it projects, and gives attachment to the internal lateral ligament, and the pronator teres and flexor sublimis muscles ; externally it is marked with a concave articular surface, elongated from before backwards, termed the *lesser sigmoid cavity* of the ulna, which receives the lip or edge on the upper extremity of the radius ; in front of and behind this surface is attached the orbicular ligament of the radius ; these two processes are connected anteriorly by a smooth articular surface, concave from above downwards, convex from side to side, partially divided by a transverse depression into two surfaces, of which the upper vertical portion is the larger ; it is also divided from above downwards by a vertical ridge into two lateral surfaces nearly equal in size, the internal being, in general, somewhat larger : this is the *great sigmoid cavity* ; it articulates with the

trochlea of the humerus, and is continuous with the *lesser sigmoid cavity*; the *body* or *shaft* of the ulna is triangular, and therefore presents three surfaces and three edges; the *anterior* surface concave, gives attachment to the flexor profundus superiorly, the pronator quadratus inferiorly, and is marked towards its upper part by the foramen, for the nutritious artery, directed upwards; its *posterior* surface irregular, is divided by a line which commences at the lesser sigmoid cavity, and descends, first obliquely, then vertically, into two surfaces, an internal and external; of these, the internal larger, broad above, narrow below, gives attachment superiorly to the anconæus, inferiorly to the flexor carpi ulnaris; the external narrow, gives attachment to the supinator brevis and extensor muscles of the thumb; the *internal* surface flattened, and slightly concave above, rounded and convex below, gives origin superiorly to the flexor profundus; inferiorly it is subcutaneous; of the *three edges*, the *external* or radial, sharp and projecting above, rounded below, gives attachment to the interosseous membrane; the *anterior* rounded, gives insertion to the flexor profundus and the pronator quadratus; the posterior, well marked superiorly, but lost inferiorly, commences at the termination of the triangular surface already described; it is subcutaneous, projects much, and gives insertion to the tendinous aponeurosis of the fore-arm; the *inferior extremity* of the ulna, unlike that of the radius, is much smaller than the superior; it expands a little, and is marked by two articular surfaces, an external and an inferior; the external is convex, long from before backwards, and articulates with the radius; the inferior is

somewhat circular, nearly plane, and corresponds to the inter-articular cartilage of the wrist joint; it is bounded internally by a depression, into which is implanted the apex of this cartilage; internally and posteriorly the ulna terminates in a long pointed and slightly curved process, termed the *styloid process*, which gives attachment to the internal lateral ligament of the wrist joint: on the posterior surface of this process is a deep groove which transmits the tendon of the flexor carpi ulnaris, and externally and near its root is the depression already described for the apex of the inter-articular cartilage.

The structure of the ulna is the same as all long bones; it is developed by five points of ossification, one each, for the upper and lower extremities, the body, the olecranon and coronoid processes; it articulates with but two bones, the humerus above and the radius above and below; when placed in situ it descends obliquely outwards from the humerus; its coronoid process is turned forwards and its styloid process backwards and inwards; its inferior articulating surface for the radius outwards and forwards.

THE BONES OF THE HAND.

The bones of the hand consist of the *carpal*, *metacarpal*, and the phalanges.

The *carpal bones* are eight in number, and are divided into two rows, a superior and inferior or carpal and metacarpal; each containing four bones: the superior row contains from without inwards, the *os scaphoides* or *naviculare*, the *os lunare*, the *os cuneiforme* or *pyramidale*, and the *os pisiforme*; the inferior, the *os trapezium*, *os trapezoides*, *os magnum*, and *os unciforme*.

The *os scaphoides* is placed obliquely in the most external part of the first row between the radius superiorly, the second row inferiorly, and the *os lunare* internally; it is the largest of this row, is curved and elongated downwards and outwards; it has three articular, and three non-articular surfaces; of the former, the superior turned outwards is convex, and marked with a triangular articular surface for the lower extremity of the radius, the inferior turned downwards and outwards, is convex, elongated transversely for articulation with the trapezium and trapezoides; the internal is marked by two articulating surfaces, a superior convex, smaller and semilunar, articulates with the *os lunare*; the inferior concave and larger for articulation with the head of the *os magnum*; the anterior, posterior, and external surfaces are the non-articular, and are rough for the attachment of ligaments; into the external is implanted the external lateral ligament of the wrist joint; it articulates with five bones—the radius superiorly, the trapezium and trapezoides inferiorly; the *os lunare* and *os magnum* internally; to place it in situ its deep concave articular surface for the head of the *os magnum* must be directed downwards and inwards; the semilunar articular surface inwards; its convex surface marked with a long narrow groove for the attachment of ligaments upwards, backwards and outwards.

The *os lunare* is next in size of the first row, and is internal to the last, it lies between it externally, the cuneiform-bone internally, the radius superiorly, and the second row inferiorly; it is irregular in shape, and has four articular, and two non-articular surfaces: of the former, the superior is convex and

encrusted with cartilage for articulation with the radius; the inferior elongated from before backwards is concave, and articulates with the os magnum and a little with the os unciforme: the external is concave and semilunar, whence its name, and articulates with the os-scaphoides; the internal is convex, quadrilateral, and articulates with the cuneiforme; of the latter, the anterior and posterior are rough for the attachment of ligaments; the anterior is the largest surface of the bone; it articulates with five bones, the radius above, the os magnum and unciforme below; the scaphoid externally, and the cuneiforme internally; when placed in situ its largest (non-articular) surface is turned forwards; its semilunar convex articular surface outwards and a little upwards; its deep concave surface downwards.

The *os cuneiforme* or *pyramidale* is next of the first row in size to the former, and is placed in the inner side of the carpus between the ulna superiorly, the unciform bone inferiorly, and the os lunare externally, on a plane inferior to it; it is of a wedge shape, the base turned upwards and inwards, the apex downwards and outwards; it has four articular, and two non-articular surfaces—of the articular the superior directed a little inwards, is convex, and corresponds to the triangular cartilage of the wrist joint which separates it from the ulna; the inferior directed outwards, is concave, and articulates with the unciform; the external concave, quadrilateral and turned upwards, articulates with the lunare; the anterior is convex, circular, and articulates with the os pisiforme; this surface is bounded superiorly by a rough surface which gives attachment to ligaments; of the non-articular surfaces, the posterior

and internal, are rough for the attachment of ligaments; it articulates with three bones: the os lunare externally; the os unciforme inferiorly, and the os pisiforme anteriorly; and the fibro-cartilage already mentioned; when placed in situ its convex circular articular surface for the os pisiforme is directed forwards its longest (non articular surface) inwards, its base upwards and outwards, its apex downwards and inwards.

The *os pisiforme* is the smallest of the carpal bones, and is situated on the anterior surface of the last described bone, and on a plane anterior to the remainder of the first row of bones; it is named from its resemblance in shape to a pea: it is nearly circular, and possesses but one articular surface which is placed on its posterior part, is concave, elongated forwards and outwards, and articulates with the cuneiform bone; the rest of the bone is convex and rough, and gives attachment superiorly to the flexor carpi ulnaris tendon; inferiorly to the abductor minimi digiti; anteriorly to the anterior annular ligament and in the rest of its extent to ligaments connecting it to the metacarpal bone of the fifth finger and unciform bone; it articulates with but one bone, the cuneiform; when placed in situ, its articular surface looks backwards and is directed obliquely forwards and outwards; its most projecting point upwards, and its sloping non-articular surface outwards.

The *os trapezium* is placed obliquely in the outer part of the second row of carpal bones, between the scaphoid above; the first and second metacarpal bones below, and the trapezoides internally; it is exceedingly irregular in shape, and is at once

recognised by a deep groove in its anterior surface it has three articular, and three non-articular, surfaces; of the former the superior is concave and triangular to articulate with the scaphoid; the inferior is concave from side to side, convex from before backwards to articulate with the first metacarpal bone; the internal is divided into two concave surfaces by a ridge, of which the inferior is small to unite with the second metacarpal bone; the superior larger joins the trapezoides, these are continuous with the superior articulating surface; of the latter the posterior and external are rough for the attachment of ligaments, the latter gives attachment to the external lateral ligament of the wrist joint; the anterior surface is marked by a deep groove directed forwards and outwards, which gives passage to the tendon of the flexor carpi radialis, and into the edge of which are implanted the anterior annular ligament and the origins of the abductor and flexor ossis metacarpi pollicis muscles; it articulates with four bones: the scaphoid above, the first metacarpal bone inferiorly, the second metacarpal bone and the trapezoides internally; when placed in situ the groove is directed forwards and descends a little outwards; its articular surface for the first metacarpal bone looks downwards and outwards.

The *os trapezoides* is the smallest bone of the second row, and is placed between the scaphoid above, the os trapezium externally, the os magnum internally, and the second metacarpal bone inferiorly; it is somewhat of a wedge shape expanded towards the dorsum, contracted towards the palm of the hand; its long axis is directed from before backwards; it has four articular, and two non-

articular surfaces; of the articular, the superior is small, concave and quadrilateral, and articulates with the scaphoid bone; the inferior is unequally divided into two by a ridge running from behind forwards; it is concave in this direction, convex transversely, and articulates with the second metacarpal bone; the external is convex, and articulates with the trapezium; the internal is marked posteriorly with a concave small articular surface for the os magnum, in front of which is a rough surface for the attachment of ligaments; of the non-articular surfaces, the posterior is large, the anterior small, they are both rough for the attachment of ligaments; it articulates with four bones: the scaphoid above, the second metacarpal bone below, the os magnum internally, and the trapezium externally: when placed in situ its long axis is directed from the dorsum to the palm of the hand; its largest non-articular surface is turned backwards; its largest articular surface for the second metacarpal bone downwards and its smallest inwards.

The *os magnum* is the largest of the carpal bones, and is nearly in the centre of the second row, between the first row superiorly, the metacarpus inferiorly, the os trapezoides externally, and the unciform internally; it is elongated from above downwards, wide posteriorly, narrow anteriorly; four of its surfaces are articular, two non-articular; of the articular the superior, called also its head, is convex, and received into a cavity formed by the scaphoid and lunar bones; it is supported by a contracted part of the bone, termed the neck; the inferior is divided into three facettes which articulates with the second, third, and fourth metacarpal bones; the middle

facette is the largest, the internal the smallest ; the external surface, nearly plane, articulates with the trapezoides, the internal long from above downwards, articulates with the unciform ; the non-articular surfaces are the anterior and posterior ; these are both rough for the attachment of ligaments ; the posterior is much the larger ; the os magnum articulates with seven bones, the scaphoid and lunar above, the second, third, and fourth metacarpal bones inferiorly, the trapezoides externally, and the unciform internally ; when placed in situ the head is turned upwards and somewhat backwards ; its inferior articular surfaces for the metacarpal bones downwards, the smallest of the three being internal ; its large non-articular surface backwards.

The *os unciforme* is the second largest bone of the carpus, and occupies its inferior internal part, between the first row above the metacarpal bones inferiorly, the os magnum externally, and the cuneiform bone internally ; it is somewhat wedge-shaped, having the apex turned upwards ; it is easily recognised by its hook-like process, whence it has received its name ; it has three surfaces articular, two non-articular ; of the former the external is marked towards its upper and back part by an articular surface nearly plane, for junction with the os magnum ; in front of which is a rough surface for the attachment of ligaments ; the internal is irregularly excavated for articulation with the cuneiform bone ; these two surfaces meet superiorly in an edge, articulated with the os lunare ; the inferior is divided into two articular surfaces by a ridge directed from behind forwards for connexion with the fourth and fifth metacarpal bones ; of its non-articular surfaces

the posterior is rough, convex, and gives attachment to ligaments; the anterior is concave, and has arising from its internal inferior part a process of bone, termed the hook-like process, turned forwards and outwards, concave externally, convex internally which gives attachment to the anterior annular ligament of the carpus, and some of the muscles of the little finger. The unciform bone articulates with five bones: the lunar above, the os magnum externally, the cuneiform internally, and the fourth and fifth metacarpal bones inferiorly; when placed in situ its hook-like process projects into the palm of the hand; its deeply excavated articular surface is turned upwards and inwards, and its double articular surface for the metacarpal bones downwards.

The *Bones* of the carpus belong to the class *Irregular*; their structure therefore is spongy, covered with a thin layer of compact tissue, hence their great liability to caries; they are developed from a single point of ossification with the exception of the unciform, which possesses two; the os pisiforme is not ossified till approaching puberty; it might be described as a sesamoid bone, being developed in the tendon of the flexor carpi ulnaris, as the patella is in the tendon of the rectus.

The *Metacarpal Bones* are five in number; they are named in their numerical order from the radius to the ulna, and extend from the carpus to the phalanges; they belong to the class of long bones and may be divided each into a superior or carpal extremity, a body or shaft, and an inferior or phalangeal extremity.

The *first metacarpal bone* is the shortest and strongest; its superior or carpal extremity is marked

with an articular surface, convex from side to side, concave from before backwards to unite with the trapezium; externally it gives attachment to the extensor ossis metacarpi pollicis, its body is flattened posteriorly, is convex, and covered by the extensor tendons; anteriorly it is concave, and gives attachment to the opponens pollicis, and the short flexor; internally, the first dorsal interosseous muscle is implanted into it; its phalangeal extremity or head is convex, quadrilateral, and marked with an articular surface extending towards the side of flexion, for junction with the first phalanx; anteriorly are two depressions which correspond to the two sesamoid bones; and laterally are rough surfaces for the attachment of ligaments; the articulating surface has been erroneously described as triangular or wedge-shaped, in order to account for the difficulty experienced in reducing the dislocation of this articulation, termed Hey's Dislocation of the Thumb.

The *second metacarpal bone* is the longest; its carpal extremity is concave from side to side, and is marked by three articulating surfaces, an external small one directed outwards for the trapezium, a central large for the trapezoides, and an internal small, directed inwards for the os magnum, posteriorly it is rough, and presents a projecting eminence which gives attachment to the tendon of the extensor carpi radialis longior; anteriorly it is also rough and gives insertion to the flexor carpi radialis tendon; externally it is rough for the attachment of ligaments; internally it is marked by a small articular surface where it is in contact with the third metacarpal bone; its body is somewhat triangular, flat posteriorly, where it is covered by the extensor tendons, narrow and excavated

anteriorly to give lodgement to the flexor tendons, externally it is concave, and gives attachment to the first dorsal interosseous muscle; internally it is also concave, and gives attachment anteriorly to the first palmar interosseous muscle; its inferior or phalangeal extremity is oblong from before backwards, convex, and articulates with the first phalanx of the corresponding finger; it is covered by cartilage which passes further towards the palm than the dorsum of the hand, on each side of this are rough surfaces for the attachment of ligaments; it has no lateral articulations at this extremity.

The *third metacarpal bone* is next in size and length to the preceding; its carpal extremity presents a concave triangular articulating surface for the os magnum, and has, on each side of these, surfaces for articulating with the adjoining metacarpal bones; in other respects this bone resembles the preceding; its posterior surface is covered by the extensor tendons, and gives attachment superiorly to the tendon of the extensor carpi radialis brevior; its anterior surface gives origin superiorly to the flexor brevis pollicis, inferiorly to the adductor pollicis; externally the second, and internally the third dorsal interosseous muscle arise from it; inferiorly it articulates with the first phalanx of the third finger.

The *fourth metacarpal bone* is shorter than the preceding; its carpal extremity presents two articular surfaces, an external small for the os magnum, an internal large for the unciform bone; on each side of these, articular surfaces for the adjoining metacarpal bones; its body resembles the preceding, externally it gives attachment to the second palmar interosseous muscle, and the third dorsal; internally to the fourth

dorsal; its inferior extremity resembles that of the preceding, and articulates with the first phalanx of the corresponding finger.

The *fifth metacarpal bone* is smaller than the preceding; its carpal extremity presents a concave articular surface, directed outwards for the unciform bone; to the radial or outer edge of this is an articular surface for the fourth metacarpal bone, and at the ulnar or inner side, a rough surface for the insertion of the extensor carpi ulnaris tendon; its body more flattened than that of the others, is divided posteriorly by a line directed forwards and outwards into an external and internal surface; the external concave gives attachment to the fourth dorsal interosseous muscle, the internal convex is covered by the extensor tendons of the little finger; the inferior extremity resembles the preceding, and articulates with its corresponding phalanx. The Student may remark that the four inner metacarpal bones are nearly parallel, but that the first is placed obliquely with respect to them, and on a plane anterior, in such a position as that the thumb may be opposed to the other fingers. The metacarpal bones belong to the class of long bones; their structure, etc., is the same as those in general; they are developed by two points of ossification, one for the body, and one for the phalangeal extremity, with the exception of the first, whose second point of ossification is formed for its carpal extremity. The metacarpal bones are supported by the carpal as follows: The first by one, the trapezium; the second by three, the trapezium, trapezoides, and os magnum; the third by one, the os magnum; the fourth by two, the os magnum and unciform; the fifth by one, the unciform; to place

them in situ, the irregular articular surfaces must be directed upwards towards the carpus, the rounded heads downwards, the broad convex surfaces backwards, the narrow forwards.

The *phalanges* are fourteen in number, three for the four inner fingers, and two for the thumb, they form the fingers ; they are named in their numerical order from above downwards, viz: the *first* or *metacarpal phalanx*, the *second* or *middle*, the *third* or *ungual phalanx*. The *first* or *metacarpal phalanx*, by much the longest, presents superiorly a concave oval articular surface, elongated transversely for articulation with the head of the metacarpal bone, and on each side of this, rough surfaces for the attachment of ligaments ; its body, contracting in size as it descends, is convex posteriorly and covered by the extensor tendons, concave anteriorly where it forms a channel for the passage of the flexor tendons, into the edges of which the sheaths of these tendons are implanted, the inferior extremity is elongated transversely, concave from side to side, convex from before backwards, to unite with the corresponding surface of the second phalanx, and is marked by rough surfaces laterally for the attachment of ligaments. The first phalanx of the third or middle finger is the longest, that of the little finger the shortest and smallest. The *second* or *middle phalanx* is the next in size and length, the thumb wants this phalanx ; its superior extremity presents a transversely oval articular surface, convex from side to side, concave antero-posteriorly to unite with the corresponding surface on the first phalanx, on each side of this rough surfaces for the attachment of ligaments ; its body convex posteriorly is covered by

the tendinous aponeurosis derived from the extensor tendons, the lumbricales and interossei muscles, concave anteriorly to give lodgement to the flexor tendons, and marked on either side near the centre by rough projecting surfaces, into which are implanted the tendons of the flexor sublimis; its inferior extremity resembles that of the first phalanx: *The third or ungual phalanges* are five in number and present superiorly an articulating surface convex transversely, concave from before backwards, to unite with the corresponding surfaces on the second phalanges; inferiorly they become thin and pointed, and terminate by a rough eminence which gives insertion anteriorly to the tendons of the flexor profundus, posteriorly supports the nails; the largest is that of the thumb; the smallest that of the little finger.

The first and second phalanges may be classed amongst the long bones; they present all their characters; the third belong to the irregular bones, and are, like these, spongy in their structure; they are developed from two points of ossification, one for the centre, and one for the superior extremity, connected with the under surface of the head of the first metacarpal bone of the thumb are two sesamoid bones; these, like those of the foot, are to give attachment to muscles and to obviate the effects of friction.

SECTION II.

THE ARTICULATIONS OF THE UPPER EXTREMITY.

The articulations of the upper extremity are the *sterno-clavicular* articulation, the *scapulo-clavicular*,

the *scapulo-humeral* or *shoulder joint*, the *elbow joint*, the *superior* and *inferior radio-ulnar articulations*, the *wrist joint*, and the *carpal*, *metacarpal*, and *phalangeal* articulations.

THE STERNO-CLAVICULAR ARTICULATION.

The *sterno-clavicular articulation* is formed, as its name implies, between the sternum and clavicle ; for this purpose the *sternum* presents on its upper surface, and near its external and posterior part, an articular surface of small extent, concave from above downwards, convex from before backwards, directed backwards and outwards, which receives the sternal end of the clavicle ; this is much larger, triangular, concave and convex in opposite directions, and projects beyond the sternum superiorly and anteriorly ; both these surfaces are encrusted with cartilage, and are connected by the *anterior* and *posterior sterno-clavicular*, and the *inter-clavicular* ligaments, an *inter-articular cartilage* and a *synovial membrane*.

The *anterior sterno-clavicular* ligament arises narrow and pointed from the anterior surface of the sternal extremity of the clavicle, passes downwards and inwards, expands, and is attached to the anterior surface of the sternum where it is lost in the aponeurosis covering this bone, and derived from the sterno-mastoid and pectoralis major muscles ; its posterior surface is covered by the synovial membrane, and corresponds to the interarticular cartilage ; its anterior corresponds to the sterno-mastoid muscle and integuments.

The *posterior sterno-clavicular* ligament arises from the posterior part of the sternal extremity of the clavicle, descends inwards, and is inserted into the posterior surface of the sternum; it is not so well marked as the anterior; anteriorly it adheres to the interarticular cartilage and the synovial membrane; posteriorly it corresponds to the sterno-hyoid and thyroïd muscles.

The *inter-clavicular ligament* has no immediate connexion with the joint; it is placed behind, and a little above the upper extremity of the sternum, and stretches transversely from the sternal extremity of one clavicle to that of the other; it is exceedingly variable as to size, etc., sometimes it presents itself as a round fibrous chord, sometimes as a thin flattened membrane; it is a little arched, having its concavity turned upwards; its upper edge gives attachment to the cervical fascia; its lower is prolonged on the posterior surface of the sternum, and is connected with the other ligaments of this articulation; its posterior surface is related to the parts passing through the upper opening of the thorax; its anterior is subcutaneous and may be felt when well marked in the living subject; its principal use is to connect the clavicles together: on cutting into this articulation the student will expose the interarticular cartilage; this is a somewhat circular plate of fibro-cartilage placed between the clavicle and sternum, having its surfaces convex and concave to accommodate itself to the articular surfaces of the bones; like all interarticular cartilages it is thick in the circumference, is thin and sometimes perforated in the centre; superiorly and externally it is thick and strong, and is attached to the sternal

end of the clavicle; inferiorly and internally it is thin and continuous with the cartilage of the first rib; anteriorly and posteriorly it has attached to it the anterior and posterior sterno-clavicular ligaments; its use is to increase the surfaces for articulation, to follow the head of the clavicle in the motions of the joint, and, by its elastic nature, to prevent shocks from being transmitted along the clavicle to the thorax; this cartilage, when perfect, separates the *synovial membrane* of the articulation into two sacs, an internal and external; the internal lines the sternum and opposed surface of the cartilage; the external the head of the clavicle and the opposite side of the cartilage; when imperfect, as it is sometimes in the centre the two synovial sacs become continuous; this membrane also lines the inner surface of the ligaments immediately connected with the joint.

This articulation belongs to the class Arthrosis, its motions are not extensive, and are so connected with those of the scapula, that it may be said to be the centre of motion of this bone on the trunk; it enjoys every motion in a slight degree, except rotation.

As we pass outwards, we find that the clavicle is connected by ligaments to the first rib and the coracoid process of the scapula, without forming any articulation; the first of these we meet with is the *costo-coracoid* ligament, frequently described along with the preceding articulation, but which has no connexion with the joint; it is called also the *costo-clavicular* ligament or the *ligamentum bicornis*; it is exceedingly variable as to size, shape, etc., being sometimes strong and well marked so as to be

apparent in the living subject, and sometimes presents only the appearance of a thin facsia ; this renders its dissection difficult to the student ; it is attached internally by means of a strong, well marked band of fibres, to the cartilage, upper edge, and outer surface of the body of the first rib ; some of its fibres pass inwards, but the greater number are directed upwards and outwards, and are implanted into the under surface of the clavicle, dividing as it passes outwards, into two layers, which enclose the subclavian muscle, and finally are inserted into the coracoid process of the scapula ; the layer which covers the anterior surface of the muscle is much better marked than that covering the posterior surface ; internally and externally, this ligament is in general well defined, but becomes thin and aponeurotic in the centre ; its inferior edge is free, lunated, directed backwards, and corresponds to the axillary vein ; its internal extremity is sometimes described as a distinct ligament, under the name of the *rhomboid* ligament ; it is this ligament which renders it difficult to compress the axillary artery immediately below the clavicle.

External to this ligament, and near its outer extremity we meet with the ligaments connecting the clavicle to the coracoid process of the scapula ; these are the *conoid* and *trapezoid* ligaments : the first of these, as its name implies, is of a conical shape ; its base, turned upwards, is attached to a tubercle on the under surface of the clavicle ; its apex, directed downwards, is inserted into the posterior expanded portion of the coracoid process ; it is placed internal and posterior to the other, and descends nearly vertically.

The *trapezoid* ligament is of a quadrilateral shape, is attached superiorly to an oblique line on the under surface of the clavicle, passes obliquely downwards, forwards, and inwards, and is inserted inferiorly into the upper surface of the coracoid process near its base; it lies external and anterior to the conoid ligament; its upper surface looks forwards and inwards; its lower, backwards and outwards; anteriorly these ligaments are separated by a triangular interval, filled with cellular substance, and the insertion of the subclavian muscle; posteriorly they are continuous with one another, hence they have been described by some as one ligament, under the name of coraco-clavicular ligament; they assist in preventing displacement of the clavicle upwards, support the scapula, and prevent the neck of this bone from falling downwards when fractured.

THE SCAPULO-CLAVICULAR ARTICULATION.

This articulation is formed between the external end of the clavicle and the inner edge of the acromion process, the former is marked by an oblique articulating surface, cut off obliquely downwards and inwards, and from before backwards, nearly plane, which rests on the acromion process, and which presents a corresponding articulating surface for its reception; they are held together by the *superior* and *inferior* ligaments; the *superior* ligament is attached internally to the upper surface of the sternal extremity of the clavicle, passes forwards and outwards, and is implanted into the corresponding surface of the acromion process; this ligament intermingles its fibres with the tendinous aponeuroses of the deltoid and

trapezius muscles ; the *inferior* ligament has similar attachment to the preceding, but on the under surface of the bones ; it is, in general, not so well marked ; anteriorly these ligaments are continuous with one another. The articulation is lined internally by a synovial membrane, and is occasionally provided with an *interarticular cartilage*, variable in size, shape, etc., when this exists, the synovial membrane consists of two sacs ; this articulation belongs to the class *Planiform* ; its motions are obscure, and need not be particularly described, they are connected with those of the scapula.

LIGAMENTS OF THE SCAPULA.

The scapula has attached to it three ligaments which may be called the *proper* ligaments of this bone, as they are not connected with any other ; they are—the *superior*, *posterior*, and *inferior*.

The *superior proper* ligament also called the *deltoid*, *triangular*, or *coraco-acromial* ligament, stretches, as its name implies, between the coracoid and acromion processes, above, and a little internal to the shoulder joint ; it is of a triangular shape, its base is attached anteriorly to the coracoid process, from this it passes upwards, backwards, and outwards, and is inserted by its apex into the acromion process ; near the coracoid process this ligament is flat, and seems to be divided into two fasciculi ; these, however, unite at the acromion, where they become round and thick ; its upper surface is covered by the clavicle and deltoid muscle, from which it is separated by cellular substance ; its under corresponds to the head of the humerus with the intervention of a large bursa

mucosa; its posterior edge is well marked; its anterior is thin and lost on the capsular ligament of the scapulo-humeral articulation; its principal use is to protect the shoulder joint from being dislocated upwards, by completing the arch formed above the head of the humerus by the coracoid and acromion processes; it will support the neck of the scapula when fractured.

The *posterior proper ligament* is situated immediately behind the root of the coracoid process, from the base of which it passes backwards over the notch in the superior costa of the scapula, and is inserted into the opposite edge of the notch; it converts this notch into a foramen, which is traversed by the suprascapular nerve, whilst the artery of the same name passes in general above it, it gives origin to the omohyoid muscle, and is frequently converted into bone.

The *inferior proper ligament* has lately been described by Sir A. Cooper, who has given it the name of the *spino-glenoid* ligament; it arises from the anterior edge of the root of the spine of the scapula, passes forwards, and outwards, and is inserted into the upper part of the neck of the bone; it is seldom well marked; it has been said to retain the glenoid cavity in situ when the neck of the scapula is fractured.

THE SCAPULO-HUMERAL ARTICULATION, OR SHOULDER JOINT.

This articulation is formed by two bones, the *scapula* and *humerus*; the *scapula* presents for this purpose at its anterior angle, an articulating surface, termed the *glenoid cavity*; this is of an ovoid shape, having its longest axis directed vertically; its larger

extremity is turned downwards, its smaller upwards, where it terminates, nearly in a point, and gives attachment to the tendon of the biceps muscle; it is superficial, but is considerably deepened in the recent state by the cotyloid or glenoid ligament which surrounds it, and by the cartilage, which is for this purpose thick at the circumference, thin in the centre; the aspect of the glenoid cavity is upwards, forwards, and outwards; if a line be drawn vertically downwards from its apex, it will divide the cavity into two parts, an internal and external; of these the internal is smaller, a fact which is said to explain the frequency of dislocation downwards and inwards; the glenoid cavity of the scapula is supported by the anatomical neck, which is that part of the bone immediately posterior to it; it is better marked inferiorly than superiorly, and gives attachment to the capsular ligament; it is called anatomical to distinguish it from that part where fracture occurs, which is through the notch in the upper edge of the scapula behind the coracoid process. The part of the *humerus* which forms this articulation is the head; this a round hemispherical convex eminence much larger than the glenoid cavity, and situated at the upper, internal, and posterior part of the bone; it is lined by cartilage which is thickest in the centre, and passes farther outwardly on the upper than the under surface of the bone; its aspect is upwards, backwards, and inwards; it is placed internal and posterior to the shaft of the bone, it is supported by the *anatomical neck* of the humerus; this is a rough surface immediately external to it which gives attachment to the capsular ligament; it is narrow and rough superiorly, more extensive and smoother

inferiorly ; it is set off from the shaft of the bone so as to form an angle with it ; it is called *anatomical*, to distinguish it from the *surgical neck* of the bone which is that part between the tuberosities and the insertion of the deltoid muscle.

THE LIGAMENTS OF THE SHOULDER JOINT.

The ligaments connecting these bones and forming the articulation, are the *capsular*, the *coraco-humeral*, or *accessory*, the *gleno-humeral*, and the *cotyloid* ligament, lined by synovial membrane.

The *capsular ligament* is exposed on throwing down the deltoid muscle ; it is attached superiorly, round the anatomical neck of the scapula beyond the cotyloid ligament ; from this it passes downwards, forwards and outwards, and is inserted inferiorly into the anatomical neck of the humerus descending below the tuberosities to which it is attached ; it is much larger here than at the scapula, and hence is of a conical shape, the apex towards the scapula, the base at the humerus ; the reverse directly of the capsular ligament of the hip joint ; this ligament is exceedingly thin anteriorly and posteriorly, but is strong towards its upper and inner part, where it is strengthened by the accessory or coraco-humeral ligament, and inferiorly towards the axilla ; externally it is closely connected to the several muscles surrounding the articulation ; it is perforated by the long tendon of the biceps anteriorly, the sub-capsular tendon internally, and sometimes by the supra-spinatus tendon superiorly ; its internal surface is lined by the synovial membrane ; in order to allow of the great mobility of the articulation, it does not connect

the bones closely together, but allows of their separation to the extent of at least an inch; this occurs occasionally even in the living subject, as in paralysis of the deltoid muscle, etc., and, no doubt, favours dislocation.

The *coraco-humeral* or *accessory* ligament is situated at the upper and inner part of the articulation; it is attached superiorly to the outer edge and under surface of the coracoid process, directs itself downwards and outwards, and is implanted into the anterior part of the greater tuberosity of the humerus; this ligament is almost identified with the capsular ligament, and appears sometimes merely as a few irregular fibres appended to it.

The *gleno-humeral* ligament, or Flood's ligament, as described by Dr. Flood of this city, "is remarkable on account of its striking analogy to the *ligamentum teres* of the hip joint. It is a process of synovial membrane arising by two roots; one from the superior, and the other from the inferior angle of the notch in the margin of the glenoid cavity. It then follows the internal border of the long head of the biceps, and is inserted in a pit in the anatomical neck of the humerus, close to the internal margin of the bicipital groove. The best view of it may be had by cutting across the inferior or axillary portion of the capsular ligament, and throwing back the arm over head and neck." The student may now divide the capsular ligament along with the biceps tendon: he will thus bring into view the *cotylloid ligament* and the *synovial membrane*, together with the biceps tendon traversing the joint.

The *Cotylloid* or *glenoid* ligament is placed around

the brim of the glenoid cavity, to which it intimately adheres; superiorly it is continuous with the long head of the biceps, by the splitting of which it is said to be formed, or, according to some anatomists, forms this tendon; it is triangular, the base attached, the apex free; it is deeper posteriorly than anteriorly; its structure is fibro-cartilaginous, the fibres running obliquely towards the bone; its use is to deepen the glenoid cavity so as to prevent dislocation, and to give origin to the tendon of the biceps.

The *synovial membrane* of this articulation is extensive, and rendered complicated by the passage of the tendon of the biceps which is in the interior of the articulation, though external to the membrane which invests it; let us commence it at the origin of this tendon from the glenoid cavity; from this the synovial membrane passes downwards, surrounding this tendon into the bicipital groove which it lines sometimes to the extent even of an inch; here it becomes reflected from the tendon all round forming a cul-de-sac; superiorly it passes off, lining the capsular ligament which conducts it directly to the cotyloid ligament; internally it passes backwards, lining the inner surface of the tendon of the sub-scapular muscle, which here conducts it to the scapula; externally it is reflected on the capsular ligament, and thus reaches the scapula, lining the tendon of the supra-spinatus at the upper part, and occasionally that of the infra-spinatus; inferiorly it passes off from the tendon of the biceps, envelopes the head of the bone passing down to a short distance on the neck, forming folds termed retinacula; from this it is reflected on the capsular ligament, and thus reaches the scapula; having arrived thus at the

scapula, at all these points it covers the cotyloid ligament, lines the glenoid cavity, reaches its apex, and is here continuous with the point from which we started. The upper part of this articulation is covered by a bursa which intervenes between it, the coracoid and acromion processes, and the coraco-acromial ligament; it contains much synovia, and obviates the effects of friction from the head of the bone pressing against these structures.

The shoulder joint belongs to the class Arthrosis; it is the most moveable articulation in the body; it enjoys *flexion, extension, abduction, adduction, rotation, and circumduction*; *flexion*, is bringing the extremity directly forwards; *extension*, bringing it directly backwards; *abduction* is, elevating the arm from the side: this can be carried to a considerable extent by the action of the deltoid muscle, aided by the pectoralis major, latissimus dorsi, etc., but yet very little, if any, beyond a line perpendicular to the joint, that is, until the arm forms a right angle with the trunk; apparently it may be raised in this direction, so as to form an obtuse angle with the trunk: this, however, is effected principally by the rotation of the scapula; *adduction* is bringing the arm towards the side—it is stopped by the trunk; *rotation* in the shoulder joint is very limited, in consequence of the neck being of such short extent: *circumduction*, on the contrary, is very extensive, in fact so much so, as to enable us to describe nearly a circle with the upper extremity, the centre at the articulation, the circumference at the hand: this is of great importance in the uses of the superior extremity, as it enables us to apply the hand in so many different directions; the shoulder joint is contrasted in the

two latter motions with the hip: in the former, rotation is limited, circumduction is extensive: in the latter, the reverse is the case; this is connected with the different uses of the upper and lower extremities, the former made more for motion than strength, possesses the rotatory motion, as it may be termed, near the extremity of the limb, where it is most required, between the radius and ulna; the latter possesses this motion at its upper part, the fibula being firmly fixed to the tibia, in order that the security of the limb inferiorly may not be compromised, as it has to support the whole weight of the body. This articulation is exceedingly liable to dislocation, this results from the superficial excavation of the glenoid cavity, the great size in comparison of the head of the bone, the lax and weak state of the capsular ligament, and the extensive motions it enjoys; were it not, in fact, for the assistance which the surrounding tendons, bones, etc., give to the articulation, and the great mobility of the scapula which follows the head of the bone like a faithful friend, dislocation would be almost inevitable on the slightest exertion.

THE HUMERO-CUBITAL ARTICULATION OR ELBOW JOINT.

This articulation is formed by three bones; the *humerus*, the *ulna*, and the *radius*. The lower extremity of the *humerus* which assists in forming this articulation presents, for this purpose, a row of eminences and depressions, directed nearly transversely, but with a degree of obliquity backwards and inwards, which receive and are received into

corresponding surfaces on the radius and ulna; the parts forming the articulation, and which we meet with on it passing from without inwards, are, a rounded articular surface, convex, turned forwards, termed the *capitulum*, which is received into the cup-like cavity in the upper extremity of the radius, and is bounded anteriorly by a depression which receives the projecting lip of this bone in extensive flexion of the elbow joint; internal to this, a depression, long from before backwards, which lodges this lip in the different motions of the radius; then the *trochlea*, a large articular surface, which is received into the great sigmoid cavity of the ulna; it is concave from side to side, convex from before backwards, directed forwards and inwards, and bounded anteriorly by the anterior humeral fossa which receives the coronoid process of the ulna in flexion of the joint, posteriorly by the posterior humeral fossa, much larger than the anterior, which receives the olecranon process, in extension of the articulation; the trochlea is bounded internally by a projecting lip of bone, the *epitrochlea*, which descends farther inferiorly than any other part of the humerus, and serves as a security to the joint in this direction; the lower extremity of the humerus is turned considerably forwards and inwards, so that the external condyle is anterior to the internal, and the articular surface of the bone looks inwards: this is connected with the motions of the joint as will be noted hereafter.

The *ulna* is marked at its upper extremity by an articular surface, the *great sigmoid cavity*, which corresponds to the trochlea of the humerus and assists in forming this articulation; this cavity is concave from above

downwards, convex from side to side ; is divided by a vertical ridge into two lateral parts, of which the internal is the larger, and also by a transverse rough depression into a superior and inferior part ; of these the superior is the larger and vertical, the inferior smaller and horizontal ; this depression, better marked internally than externally, does not completely cross the bone ; the great sigmoid cavity is bounded anteriorly by the coronoid, posteriorly by the olecranon processes, and is continuous inferiorly with a small articular surface, which the coronoid process presents on its external margin, termed the *lessor sigmoid cavity* ; this is concave and *elongated* from before backwards, and receives the head of the radius in the motions of pronation, and supination.

The part of the *radius* which forms this articulation is the head ; this presents for this purpose superiorly a circular excavation, termed the *cup-like cavity*, which receives the capitulum of the humerus ; it is lined by cartilage, and surrounded by a projecting lip of bone, the circumference of which is encrusted with cartilage extensive internally where it corresponds to the lesser sigmoid cavity of the ulna ; elsewhere of small extent where it is surrounded by the annular ligament.

THE LIGAMENTS OF THE ELBOW JOINT.

The ligaments of the elbow joint are the *anterior* and *posterior* ligaments ; the *internal* and *external lateral* ligament lined by synovial membrane.

The *anterior ligament* is situated on the anterior part of the joint, and may be exposed by throwing down the brachialis anticus muscle ; it is a thin weak

ligament, composed of fibres loosely connected together; it commences superiorly from the anterior surface of the lower extremity of the humerus above the internal condyle, and the anterior humeral fossa; from this its fibres descend, some vertically, but the greater number, and which are the most superficial, obliquely downwards, and outwards, to be attached inferiorly into the orbicular ligament of the radius; when well marked a few fibres may be traced to the coronoid process of the ulna; its anterior surface is covered by the brachialis anticus muscle, to which it is connected, but not intimately, by cellular substance; its posterior is lined by synovial membrane; it is stretched in extension of the joint, and assists in limiting this motion.

The *posterior ligament* is placed on the posterior part of the articulation, and may be exposed by detaching from it the triceps muscle; this must be done with care, as the ligament is exceedingly thin, and adheres intimately to the muscle; it is not so well marked as the preceding; it arises superiorly from the posterior surface of the humerus round the posterior humeral fossa; passes downwards, and is inserted into the summit of the olecranon process; its fibres are badly marked, and may be divided into two portions; a descending, situated on the internal part of the joint, and a transverse which is the more distinct, and crosses between the condyles of the humerus; its posterior surface is covered by the triceps tendon to which it adheres intimately, and by the anconæus muscle; its anterior surface corresponds to the synovial membrane; it is stretched in flexion of the joint, and is but little security to it.

The *external lateral ligament*; this ligament is

intimately connected with the tendinous origins of the supinator and extensor muscles, particularly that of the supinator brevis, so that the student will find much difficulty in exposing it, on cutting through the muscles, however, he will bring it into view; superiorly it is attached to the external condyle of the humerus, passes downwards, expands, and is inserted inferiorly into the orbicular or annular ligament of the radius having no connexion with the bone itself.

The *internal lateral* ligament is perfectly distinct, and lies under the origin of the flexor carpi ulnaris muscle; superiorly it is attached to the internal condyle of the humerus, from this its fibres descend in a radiated manner, and divide into two fasciculi, of which one is anterior, the other posterior, the anterior fasciculus passes downwards, and a little backwards, and is implanted into the inner surface of the coronoid process of the ulna; the posterior passes almost directly backwards, and inserts itself into the side of the olecranon process; externally it is covered by the synovial membrane, internally it has resting on it the ulnar nerve, and the anastomosis between the posterior ulnar recurrent, and the inferior profunda arteries, which must be raised to expose it; both fasciculi are stretched in flexion of the joint, particularly the posterior. On cutting into the articulation, it will be found lined by synovial membrane; anteriorly this lines the posterior surfaces of the anterior ligament, which conducts it upwards towards the humerus, is reflected on the bone, passes into the anterior humeral fossæ, reflects itself on the articular surfaces into the posterior humeral fossa, spreads out on the tendon of the triceps muscle and posterior ligament which conduct it to the

ulna; from this it spreads out, lines its two sigmoid cavities, is reflected on the neck of the radius, covers its cup-like cavity, and the inner surface of the annular ligament, whence it passes on the anterior and posterior ligaments, where it is reflected from these on the bone; it leaves triangular intervals, and covers a quantity of fatty substance lodged in the humeral fossa, and particularly in the posterior one. The elbow joint is a perfect *angular ginglymus*; its motions, therefore, are confined to flexion and extension; flexion is bending it forwards, it is limited by the coronoid process fitting into the anterior humeral fossa; in this motion the forearm is not directed upwards towards the arm, but is thrown obliquely across the chest for the purpose of defence, etc.; this is occasioned by the oblique direction of the lower extremity of the humerus as already mentioned; extension is bringing the forearm and arm on a straight line, it is stopped by the olecranon process striking against the posterior humeral fossa; in this position the articulation appears to be exceedingly insecure, as the least violence applied to the lower extremity of the ulna will act most powerfully on the articulation owing to the projection of the olecranon process, and the lever thus formed by the bone; the joint is most secure when in the semiflexed position. The student may remark that in these motions the relative bearing of the olecranon process to the condyles of the humerus is altered; in *flexion* the three eminences form a nearly equilateral triangle; the apex inferiorly at the olecranon process, the base superiorly formed by a line drawn from one condyle to the other; in *extension*, on the contrary, the three eminences are on a straight line; the knowledge of

these facts will assist him materially in distinguishing dislocations of this joint.

THE RADIO-ULNAR ARTICULATIONS.

These are two in number : the *superior* and *inferior*.

The *superior radio-ulnar articulation* is formed between the lesser sigmoid cavity of the ulna, and the lip of the radius ; the former is situated on the outer edge of the coronoid process of the ulna, is concave, larger posteriorly than anteriorly ; the latter is convex, and lined by cartilage, especially where it is in contact with the ulna ; one ligament alone exists here, this is the *orbicular* or *annular* ligament ; this is a strong resisting ligament ; anteriorly it is attached to the anterior edge of the lesser sigmoid cavity of the ulna, surrounds two-thirds of the head of the radius, passing also to a short extent on its neck, and is implanted posteriorly into the posterior edge of the lesser sigmoid cavity ; this ligament is of a strong fibrous or, in some instances, of a fibro-cartilaginous nature ; it completes the ring in which the head of the radius revolves ; becomes thin where it passes on the neck of the bone, and has inserted into it the external lateral ligament, and the anterior ligament of the joint ; externally it is covered by the supinator brevis muscle ; internally it is lined by the synovial membrane which is continuous with that of the elbow joint ; this belongs to the class *Lateral Ginglymus* ; its motions are rotatory, that is, the radius moves on its own axis ; this is different from the motion described by the lower extremity of the bone, which moves through a semi-circular space, thus forming the motions of pronation and supination.

Besides the ligaments just enumerated as being connected to these articulations, we have the *anterior* and *posterior oblique ligaments*, which cannot be classed with any particular joint.

The former, that is, the *anterior oblique* ligament, is placed in the anterior part of the forearm, between the radius and ulna; it is attached superiorly and internally to the coronoid process of the ulna, below the insertion of the brachialis anticus muscle descends obliquely outwards, lying internal to the biceps tendon and is implanted inferiorly and externally into the radius immediately below its tubercle; it lies between the biceps tendon above, and the posterior branch of the interosseous artery beneath, and separates the supinator brevis and flexor sublimis muscles; it is quite distinct from the interosseous membrane, being separated from it by a considerable interval; its direction also is precisely the reverse of this membrane, and it is placed on a plane anterior to it, which should be attended to by the student in dissecting for this ligament, as he may otherwise remove it; its use is to connect the radius and ulna; its principal use is to limit too great supination of the fore-arm; it is relaxed in pronation.

The *posterior oblique ligament* described by Sir A. Cooper, is situated at the posterior and inner part of the articulation; it stretches from the side of the coronoid process of the ulna upwards and backwards to the olecranon process; it is said to be of use in preventing the olecranon process from being drawn upwards by the action of the triceps, but is seldom sufficiently well marked to have much effect in this way.

The radius and ulna are united in the centre of the forearm by a strong fibrous structure, termed the *interosseous membrane* or *ligament*; the fibres of this ligament are strong, shining, and well marked; they are attached externally to the inner edge of the radius, descend obliquely from this, and are implanted into the opposite edge of the ulna; a few of its fibres take a contrary course; it is deficient above to a considerable extent, to give room for the origins of some of the flexor and extensor muscles, the insertion of the biceps tendon, and the transmission of the posterior interosseous artery, and also below for the passage of one of the terminating branches of the interosseous artery; in its centre it presents numerous foramina for the passage of vessels and nerves; its anterior surface is covered by the flexor profundus, flexor longus pollicis, and pronator quadratus muscles, and the interosseous artery and nerve; its posterior by the supinator brevis, extensors pollicis, and the indicator muscles; its use is, besides giving origin to these muscles, to connect the radius and ulna; it is stretched only when the bones are placed between pronation and supination.

The *inferior radio-ulnar articulation* is formed between the lower extremities of the radius and ulna where they are in contact; for this purpose the *ulna* presents, close to its inferior articular surface, and on its outer and anterior edge, a round convex surface, oblong, encrusted with cartilage, which is received into a corresponding concave surface on the radius, an arrangement precisely the reverse of that on the superior extremities of the bones; one ligament only, lined by synovial membrane belongs to this articulation, the *succiform ligament*; this

ligament, named from its resemblance to a sack or bag, envelopes the articular surface on the ulna to the edges of which, as well as to those of the articular surface of the radius it is attached; it is exceedingly thin, lax, and weak, and is lined internally by a synovial membrane, which contains much synovia; a triangular fibro-cartilage is connected with this articulation, but as it more properly belongs to the wrist joint, it will be described with it; this articulation belongs to the class of *Lateral ginglymus*; its motions are very peculiar; they are those of pronation and supination, and are performed by the *radius* moving round the ulna so as to describe a semi-circle, the *ulna* being perfectly fixed; *pronation* is a species of rotation inwards, by which the palm of the hand, owing to the close connexion this has to the radius, is turned downwards; *supination* being rotation outwards, by which the hand is thrown supine or on its dorsum; these motions are essentially different from those which occur in the superior radio-ulnar articulation, as already mentioned.

THE RADIO-CARPAL ARTICULATION, OR WRIST JOINT.

This articulation is formed by three bones, the inferior extremity of the *radius*, and two of the first row of carpal bones, viz.: the *os scaphoides* and the *os lunare*; the lower extremity of the *radius* presents for this purpose an articular surface, triangular, or nearly quadrilateral, concave, and divided by a ridge running from before backwards into two—an external and internal: the external triangular, larger than the internal, articulates with the scaphoid

bone : the internal quadrilateral, with the os lunare ; the ridge is received into the interval between these bones ; these two bones united, form a convex head, elongated transversely which is received into the concave articular surface on the radius ; the os cuneiforme does not enter into this articulation, as it corresponds to the interarticular fibro-cartilage which separates it from the ulna.

THE LIGAMENTS OF THE WRIST JOINT.

The ligaments of the wrist joint are, the *external* and *internal lateral*, the *anterior* and *posterior ligaments*, lined by synovial membrane.

The *external lateral ligament* is attached superiorly to the point of the styloid process of the radius ; from this its fibres descend, diverging, and are implanted inferiorly into the outer surface of the os scaphoides, the os trapezium, and the anterior annular ligament ; its external surface corresponds to the radial artery which winds round it ; its internal to the carpus.

The *internal lateral ligament*, not so well marked as the preceding, is attached superiorly to the point of the styloid process of the ulna, descends forwards, and is implanted into the os cuneiforme and the os pisiforme, some of its fibres passing to be continuous with the anterior annular ligament.

The *anterior ligament* is an irregular set of fibres which, from the lower extremity and anterior surface of the radius, descend to be attached into the anterior surface of the os scaphoides, os lunare, and os cuneiforme ; it is covered anteriorly by the flexor tendons, posteriorly by the synovial membrane.

The *posterior* ligament, not so strong as the preceding, is attached, like it, to the lower extremity of the radius on its posterior surface, from this, descends, and is inserted inferiorly into the posterior surface of the os lunare and os cuneiforme; its posterior surface is covered by the extensor tendons; its anterior by the synovial membrane.

On cutting into the articulation, it will be found to contain in its interior an interarticular fibro-cartilage, this intervenes between the ulna and os cuneiforme; it is triangular in shape; its apex is attached internally into the depression at the root of the styloid process of the ulna, it passes transversely outwards, and is implanted by its base into the ridge which separates the ulnar from the carpal articulating surface on the radius; its surfaces are concave, are lined by synovial membrane, and correspond to the ulna above, the os cuneiforme beneath, its edges thicker than the centre, are connected to the ligamentary fibres of the articulation, its use is the same as all interarticular cartilages; occasionally it is perforated in its centre, and then the lower extremity of the ulna comes in contact with the os cuneiforme, and thus these bones may be said to assist in forming the wrist joint; the synovial membrane, lining the articulation, covers the extremity of the radius, the under surface of the fibro-cartilage is reflected from these on the ligaments, and passes then to line the upper surface of the first row of carpal bones.

Connected with this articulation, but not exactly belonging to it, are the *anterior and posterior annular ligaments* of the wrist; these are two strong fibrous membranes, situated in the anterior and posterior part of the wrist, and surrounding it like a ring or annulus.

The *anterior annular* ligament is by much the larger, and is placed in front of the carpal bones; externally it is attached to the anterior surface of the os trapezium and os scaphoides, passes transversely inwards, and is attached internally to the hook-like process of the unciform bone, and sends a process forwards, smaller than the other, to be attached to the os pisiforme. Between these two attachments the ulnar artery and nerve pass. The anterior surface of this ligament is covered by the integuments, and is crossed externally by the superficialis volæ artery, and in the centre by a small branch of the median nerve; it gives origin externally to the abductor, opponens, and flexor brevis pollicis muscles, internally to the palmaris brevis; its posterior surface is arched, and has passing beneath it the tendons of the flexor carpi radialis, flexor profundus, flexor sublimis, and flexor longus pollicis muscles, the median nerve, and the termination of the interosseous artery entering the palm of the hand; it is here lined by a synovial sheath, which envelopes these tendons. Into its superior edge is implanted the tendon of the palmaris longus muscle, from its inferior edge arises the palmar aponeurosis; its use is to form an arch, for the passage of the above mentioned parts, to protect them from injury, and to connect the carpal bones in the transverse direction, and thus prevent the arch which they form from being obliterated, so as not to interfere with the action of the tendons.

The *posterior annular* ligament is not near so well marked as the preceding, and appears to be merely a prolongation of the fascia of the fore-arm, forming sheaths for the extensor tendons; it is attached externally to the posterior surface of the radius,

passes from this obliquely downwards and inwards, and is implanted internally into the posterior surface of the cuneiform and unciform bones, having little, if any, connexion with the ulna—a remark which applies to almost all the ligaments of the articulation ; by this means the hand is more intimately connected with the radius, and follows it in the motions of pronation and supination. The posterior surface of this ligament is covered by the integuments, its anterior corresponds to the extensor tendons and carpal bones, its edges are indistinct, its chief use seems to be to bind down the extensor tendons. The wrist joint belongs to the class *Arthrosis* ; its motions are *flexion*, *extension*, *abduction*, *adduction*, and *circumduction*. *Flexion* is bending the hand forwards towards the anterior part of the fore-arm ; *extension* is motion in the contrary direction, that is, backwards ; of these flexion is the most extensive. *Abduction* is separating the hand from the mesial line of the body, that is, approximating the thumb to the radius ; it is very limited, being prevented by the styloid process of the bone. *Adduction* is inclining the hand towards the body, or its inner edge to the ulna ; it is more extensive than the preceding, because the styloid process of the ulna, although more projecting than that of the radius, is situated rather posterior to the articulation. *Circumduction* is extensive ; it does not enjoy *rotation*, as such motion is prevented by the lateral ligaments.

THE ARTICULATION OF THE HAND.

The *articulating surfaces of the first row of carpal bones*, where they are opposed to one another, need not be again described ; they are, in general, *Arthrodial*

or *Planiform*, and are connected by *palmar*, *dorsal*, and *interosseous* ligaments; the palmar are the best marked, they stretch between the os scaphoides, os lunare, and os cuneiforme—the dorsal, weaker stretch between the same bones; where these bones are in contact they are connected by strong fibrous structures of short extent, termed interosseous ligaments; their cartilaginous surfaces are lined by synovial membranes. The *os pisiforme* is held firmly in its place by several ligaments; superiorly the internal lateral ligament of the wrist joint is attached to it, as already described; inferiorly two ligaments stretch from it, an external and internal; the external passes from it downwards and outwards, and is implanted into the hook-like process of the unciform bone; the internal, an exceedingly strong ligament, and apparently the continuation of the tendon of the flexor carpi ulnaris, descends from it inwards, to be inserted into the base of the fifth metacarpal bone, externally is attached to it a portion of the annular ligament, and its articular surface is surrounded by a capsular ligament, lined by synovial membrane.

The articulations between the first and second rows of carpal bones are remarkable; in the centre, an *enarthrodial* articulation is formed by the head of the os magnum being received superiorly into the cavity formed by the os lunare and os scaphoides; on either side of this an *arthrodial* articulation is formed, the external being between the os scaphoides above, the os trapezium and os trapezoides beneath, the internal between the os cuneiforme above, the os unciforme beneath; these articulations are connected in front and behind by palmar and dorsal ligaments, variable in extent and size, laterally by expansions, from the lateral ligaments of the wrist joint.

The *articulations between the carpal bones forming the second row* are connected in like manner, by dorsal and palmar ligaments, stretching from one bone to the other, and by interosseous structures, which exist externally between the os magnum and os trapezoides, internally between the os magnum and the os unciforme. The student may perceive that several of these ligaments stretch from the anterior surface of the os magnum to the surrounding bones, these are to keep it firmly in its situation, for although apparently the most secure bone of the carpus, it is most liable to dislocation, its head being thrown backwards towards the dorsum of the hand; this is caused by the bone being so impacted between the others as to bear a considerable portion of any violence applied to this, and from its wedge-shape, the apex turned towards the palm of the hand, force applied in any direction, except directly on its base, will have a tendency to dislocate it backwards.

The *carpo-metacarpal articulations* are formed between the second row of carpal bones, and the metacarpus; the articular surfaces need not again be particularly described, except that between the os trapezium and first metacarpal bone; they are connected by dorsal and palmar ligaments, stretching from the carpal to the metacarpal bones; of these, the dorsal are the more distinct; all these articular surfaces are lined by one synovial membrane which is continuous throughout with the exception of that belonging to the os pisiforme, which is distinct from the rest.

The *articulation between the os trapezium and the first metacarpal bone*—the cartilaginous surface on the os trapezium is concave from side to side, convex

from before backwards, that on the extremity of the metacarpal bone is the reverse ; they are connected by an irregular set of longitudinal fibres, stretching from one bone to the other, and better marked posteriorly and externally than elsewhere, lined internally by synovial membrane : it belongs to the class *Arthrosis*, and possesses considerable motion, in order that the thumb may be enabled to oppose itself to the other fingers ; its motions are *flexion*, *extension*, *lateral motion*, and *circumduction* ; it does not possess rotation ; its chief security is the great strength of the muscles of the thumb.

The inter-metacarpal articulations formed between the lateral surfaces of the superior extremities of the metacarpal bones, where they are in contact, are connected by dorsal and palmar ligaments, lined by synovial membrane, and a strong fibrous structure anteriorly, which assists in forming the fibrous sheath of the flexor tendons.

The *metacarpo-phalangeal articulations* ; these are formed by the round convex head of each metacarpal bone, being received into the concavity of the first phalanx ; they are connected by lateral ligaments on either side, and a strong ligament in front, which intermingles its fibres with the sheaths of the flexor tendons, and are lined internally by synovial membrane ; the most remarkable of these articulations is that between the metacarpal bone of the thumb and the corresponding phalanx, as it is the subject of the dislocation which has received the name of Hey's Dislocation of the Thumb ; the difficulty of reducing this dislocation has been ascribed to the wedge-shape of the articular extremity of the metacarpal bone, but on examination it will be found to be quadrilateral,

rather than triangular; they belong to the class Arthrosis, and possess every motion with the exception perhaps of rotation.

The *inter-phalangeal articulations* are formed by the phalanges; the inferior extremity of each of these is concave from side to side, convex from before backwards: the superior extremity the reverse; they are connected by lateral ligaments, and an anterior ligament, resembling that of the preceding, lined by synovial membrane; they belong to the class of angular Ginglymus, and only admit of flexion and extension.

Having now completed the description of the bones, ligaments, and articulations of the upper and lower extremities, we may be allowed to contrast their respective structures, and point out how each is best adapted for the purpose for which it was originally intended; the great characteristic differences which they present are in the two properties of mobility, and solidity, or firmness; whilst every thing seems to unite in rendering the upper extremity as moveable as possible, every thing conspires in the lower extremity to give it that resistance and security so essential in supporting the weight of the head, trunk, etc., superiorly, and that, not only in the standing position but in those violent exercises which man so frequently indulges in; let us first examine the pelvis, which although belonging to the trunk, we include in the comparison; here is a large bony cavity formed of several bones so united together that no motion whatever is permitted between them for an obvious reason; if any motion were allowed it would be perfectly useless as a connecting medium between the trunk and lower extremities; what a

contrast does the scapula present to this, formed but of a single bone, and that connected to the trunk in the most moveable manner possible, that is by muscle, and by a slender bone, the clavicle, whose use is more properly, to prevent the scapula from falling forwards, in order to give the expanded figure to the shoulders which they present, particularly in the male subject. than as a connecting medium ; then as we pass downwards, the shoulder and hip joints are contrasted in a similar manner ; in the former the head of the humerus reposes as it were on a superficial excavation, whereas in the latter the head of the femur is received into a deep cup-like cavity ; but as we descend to the farther extremity of each limb the difference is still more manifest ; the mobility enjoyed by the forearm in consequence of the great motion of the radius is remarkably contrasted with the immobility of the bones of the leg, from the firm attachment of the fibula to the tibia ; but it is between the hand and foot that the most striking contrast exists, each divided into three parts ; but how much does the tarsus exceed the carpus in size and firmness ! and how much inferior to it in mobility ! the former forms nearly one half of the foot, whereas the latter does not form even one-sixth of the hand, although it possess a greater number of bones ; the metacarpus too possesses more motion than the metatarsus, but what a contrast do the fingers present to the toes, the first formed of an equal number of bones, but of much greater length, and, therefore, endowed with greater mobility and greater powers of prehension ; the latter formed of bones of exceedingly small size, and possessed, comparatively speaking, of but little of either of those powers ; but it is in the thumb

that the hand is so superior to the foot, as an organ of prehension; this is placed so as to project externally from the carpus, and to form a considerable angle with the metacarpus, and possesses an articulation with the os trapezium, by which it is endowed with great mobility, and is thus enabled to act as an opposing member to the other fingers, the great advantage derived from the thumb; but the great toe is placed nearly parallel to the others, and therefore cannot perform this office, so that although the foot may be sometimes termed “*altera manus*,” and may even serve occasionally as a substitute for it, its very mechanical structure prevents it from ever being of that service to man that the hand is; but if the hand exceed the foot in these respects, it is inferior in the properties of firmness and elasticity; accordingly we find that the accidents which both extremities are liable to are in accordance with these properties; whilst fractures most frequently occur in the lower; dislocation is more frequent in the upper extremities. The upper extremity is placed on a plane posterior to the lower, in order that it may assist in resisting the great tendency the body has to fall forwards; and thus support the centre of gravity, as well as for other useful purposes.

CHAP. V.

THE HEAD.

The head is placed at the upper extremity of the vertebral column on which it rests, and which supports it at a right angle, but in such a way as that more of it is in front of, than behind, this column ; it performs the important office of affording lodgement to the brain and its membranes, and to the principal organs of sense ; it is in general described as being of a spherical shape, somewhat compressed laterally, but differs so exceedingly according to the age, sex, individual, country, habits, etc., that it is almost impossible to assign to it any particular form ; in inhabitants of these countries it is most frequently of an ovoid shape, its larger extremity turned posteriorly, convex above, flat and compressed laterally, rough and irregular inferiorly ; it has been divided into the *cranium* and *face* ; and accordingly, the bones which form it have been classed into those of the cranium and face ; but this is rather an artificial division, as some of the bones for instance, common to the frontal, sphenoid, and ethmoid, are both parts.

The *cranium* is a large bony cavity, occupying the superior, and most of the lateral and inferior parts of the head ; it is of an ovoid shape ; its larger extremity posteriorly, and may be divided into an *anterior part* or *forehead* ; a *posterior* or *occiput* ; a *superior* or *vertex* ; an *inferior* or *base*, and two *lateral parts* or *temples* ; it is formed by eight symmetrical bones : the *frontal*, two *parietal*, the *occipital*, two *temporal*, the *sphenoid*, and the *ethmoid*, and in general contains

irregularly developed bones, termed *ossa wormiana* or *triquetra*. Before the student proceeds to study these bones, it is necessary that he should have a perfect skull, one with the roof of the cranium removed, or, as it is called, the base of the skull, and the separated bones, and first place each bone as he is about to study it, in its natural position; for this purpose we will point out at the end of the description each bone how this is to be accomplished, to which he may refer.

The *frontal bone* is placed at the anterior and superior part of the head, forming the forehead and part of the face anteriorly, part of the cranial cavity posteriorly, the orbits and nose inferiorly, the temples laterally; it is somewhat semicircular in shape, and has not inaptly been compared to a cockle-shell; it may be divided into three *surfaces*, and a circumference; the three *surfaces* are the *anterior* or *fronto-facial*, the *posterior* or *cerebral*, the *inferior* or *orbito-nasal*. The *anterior* or *fronto-facial* surface is smooth and convex, except laterally, where it forms the temples, and is rough and concave; commencing at the mesial line, we observe occasionally, but seldom well marked, a longitudinal line which indicates the junction of the two portions of which the bone consists in the young subject; in its place a suture sometimes exists which is said to be more frequent in the female than in the male; immediately below this is the *nasal prominence*, best marked in the old subject; perforated by small foramina for the transmission of vessels, and sometimes containing the appearance of a suture; this is bounded inferiorly by a rough, irregular, and somewhat arched surface, which articulates with the nasal

bones in the centre, and with the ascending processes of the superior maxillary bones on either side; posterior to this, and directly on the mesial line, is a pointed projecting process of bone, termed the *nasal spine*; this projects a good deal forwards, supports the nasal bones superiorly, articulates with the nasal lamella of the ethmoid bone inferiorly, and laterally is marked by two longitudinal grooves which form part of the roof of the nose—on each side of the mesial line this surface of the frontal bone presents a smooth convex surface superiorly, covered by the occipito-frontalis muscle; below this is the *frontal eminence*, better marked in the young subject, and indicating where the centre of ossification originally existed; as we descend from this is a slight transverse depression, bounded inferiorly and to the inner side by a projection of the bone, best marked in the old subject, and formed by the development of the frontal sinuses, which gives origin to the corrugator supercillii muscle, and directly beneath by a projecting lip of bone, termed the *superciliary arch*; this is arched considerably in the transverse direction, and terminates at either extremity in the angular processes; the *external* of these is strong, projects outwards, and articulates with the malar bone; the *internal* is thin and not so distinct, and joins the os unguis; at the junction of the internal and middle third of the arch is the *superciliary* or *supra-orbital notch*, or *foramen*, which transmits the artery and nerve of the same name: the former a branch of the ophthalmic artery: the latter of the fifth nerve; when a notch it is converted into a foramen by a ligament; it presents posteriorly a foramen which transmits a vessel into the frontal

sinus ; this arch is covered by the orbicularis palpebrarum muscle, gives attachment to the broad ligament of the tarsus, and forms the superior part of the circumference of the orbit, of which it is the most projecting part ; laterally this surface of the frontal bone is flattened, and presents a rough concave surface which forms part of the temporal fossa, giving lodgement to the temporal muscle ; it is circumscribed superiorly by a ridge of bone which commences at the external angular process, passes upwards and backwards, and is lost on the parietal bone ; it is called the *temporal process* and gives origin to the temporal aponeurosis. The *posterior* or *cerebral surface* is concave and irregular ; is covered by the dura mater, and forms part of the anterior fossæ of the cranium, for containing the anterior lobes of the brain ; in it we observe on the mesial line, a longitudinal bony eminence corresponding to the line described on the fronto-facial surface ; this gives attachment to the falx cerebri ; it commences inferiorly by two lines, one of which passes on each side of a depression which assists the ethmoid bone in forming the foramen-cæcum ; these two lines then unite, form a single line which again bifurcates and forms a groove which contains the longitudinal sinus, and at last is gradually lost on the bone. On either side of this line this surface of the bone is irregular, and marked by the ramifications of vessels, the mamillary eminences and digital depressions, which correspond to the irregularities of the brain ; these are more remarkable inferiorly than superiorly ; inferiorly this surface of the frontal bone is completed by the *orbital processes*, two thin plates of bone quadrilateral superiorly, triangular inferiorly ; these

are exceedingly rough, convex, and slope downwards and inwards; they support the anterior lobes of the brain, and form the roofs of the orbits; they are separated by a quadrilateral excavation which lodges the cribriform plate of the ethmoid bone and the ethmoidal process of the sphenoid.

The *orbito-nasal* or *inferior surface*; this surface is irregular; in its centre is the ethmoidal depression just described; the circumference of this excavation presents anteriorly the nasal spine, and the openings of the frontal sinuses, laterally small cells which unite with the anterior cells of the ethmoid bone and two grooves which unite with this bone to form the *internal orbital foramina*, *anterior*, and *posterior*; the anterior of these is the larger, and transmits the nasal branch of the ophthalmic nerve and the anterior ethmoidal artery; the posterior transmits the posterior ethmoidal artery and a small accompanying vein; on either side of this are the under surfaces of the orbital processes; these are smooth, concave, and triangular; the apex posteriorly, the base anteriorly; they present, at the anterior external part, a deep excavation beneath the external angular process, which lodges the lachrymal gland, internally a superficial depression for the pulley of the superior oblique muscle; anteriorly the commencement of the superciliary notch or foramen.

The *circumference* of the frontal bone presents an undulating irregular line; commencing at its superior and posterior part on the mesial line, we descend outwards towards the temporal process; between these two points it is somewhat thick and serrated, and articulates with the parietal bones forming the *coronal suture*; superiorly it is cut off on its inner

surface, inferiorly, on its outer surface, so that it first overlaps, and then is overlapped by the parietal bone, passing forwards we meet with a triangular rough surface which articulates with, and rests on, the great wing of the sphenoid bone posteriorly, the malar bone anteriorly; passing directly inwards along the posterior edge of the orbital plate, it is thin and joins the lesser wing of the sphenoid which rests on it; it then passes forwards into the ethmoid notch where it is thin posteriorly, and joins the sphenoid, hollowed out anteriorly, to form the frontal sinuses, and articulate with the ethmoid; directly in front is the nasal process. The *processes* of the frontal bone are nine in number; they consist of one nasal, four angular, two temporal, and two orbital; it possesses seven foramina; five common, and two proper; the common foramina are the foramina cœcna; the anterior and posterior orbital foramina, two on each side, formed between it and the ethmoid; the proper are two supra-orbital or superciliary foramina; besides these the frontal bone assists in forming the foramen lacerum orbitale. The frontal bone articulates with all the bones of the cranium, except the temporal and occipital viz: the two parietal, the sphenoid, and the ethmoid, and eight facial bones, two nasal, two superior maxillary, two lachrymal, and two malar. Its structure is that of all flat bones, two layers of compact tissue enclosing an intermediate spongy structure termed diploe; they are hollowed out at their anterior part so as to form the *frontal sinuses*; these in the advanced period of life occupy the greater portion of the bone, extending outwardly into the orbital plates to within a short distance of the temporal

processes, and upwards to near the coronal suture; their openings are situated in the circumference of the ethmoid notch; they are generally separated by a septum, and open along with the anterior ethmoid cells into the middle meatus narium; their use seems to be to increase the size of the bone without adding to its weight; the outer table of this sinus is sometimes fractured and driven into a considerable depth, so as to present the appearance of a depressed fracture of the whole thickness of the bone; in the very young subjects these sinuses do not exist. The frontal bone is developed by two points of ossification, commencing at the frontal eminences. To place it in situ its smooth convex surface must be turned forwards, its concave backwards, and the ethmoid notch directly downwards.

The *Parietal bones* are placed, one on each side in the superior and lateral parts of the cranium between the opposite bones superiorly, the temporal and sphenoid inferiorly, the frontal anteriorly, and the occipital posteriorly; they are quadrilateral in shape, and may be divided into two surfaces, an *external* and *internal*, four *edges*, a *superior*, *inferior*, *anterior*, and *posterior*, and four *angles*, *two anterior*, and *two posterior*; the *external surface* is smooth and convex; superiorly it is covered by the aponeurosis of the scalp, and presents in its centre the parietal eminence, better marked in the young than in the old subject, which indicates the centre of ossification, immediately below this it is marked by a semicircular line, continuous anteriorly with the temporal process of the frontal, posteriorly with the horizontal root of the zygomatic process of the temporal bone, which gives attachment to the temporal aponeurosis; beneath this the bone is rough for the origin of the temporal muscle, and is cut off

inferiorly where it is overlapped by the squamous portion of the temporal bone, forming the squamous suture; in this surface we in general see a few foramina for the transmission of vessels, they are exceedingly irregular in size and existence; the *internal* or *cerebral* surface, more extensive than the external, is concave and irregular, and is covered by the dura mater, it is marked by the convolutions of the brain, particularly at its posterior inferior part, and by the branches of the middle artery of the dura mater; this vessel may be seen to cross, first the anterior inferior angle of the bone which sometimes forms a bony canal through which it passes, then ascends upwards and backwards, giving off numerous branches, both anteriorly and posteriorly; one large one, in general, grooves the bone nearly parallel to and about half an inch posterior to the coronal suture. The student should pay particular attention to the course of this vessel, as it is frequently ruptured by violent blows and falls on the cranium; near the superior edge this surface is bevelled off to form, with the opposite bone, a groove for the longitudinal sinus; it here presents numerous foramina which serve for the transmission of vessels from the exterior of the cranium, and from the bone itself into the sinus, and depressions formed by the glandulæ Pacchioni, at its posterior inferior angle it is grooved for the course of the lateral sinus. Of *the four edges*, the *superior* is the longest, is serrated and joins the opposite parietal bone, forming with it the sagittal suture; the *inferior* is the shortest and thinnest; it is arched and cut off on its outer surface where it is rough, and is overlapped by the squamous portion of the temporal bone forming the squamous future; the *anterior edge* decends a little forwards, is

is serrated, cut off superiorly on its outer surface, inferiorly on its inner, to articulate with the frontal bone, and form the coronal suture; the *posterior* is exceedingly irregular, and joins the occipital bone, forming the *lambdoidal* suture, where it frequently presents *ossa triquetra*, or wormiana; of the *angles*, the *anterior superior* angle is nearly right, and fits in between the frontal and opposite parietal; the *anterior inferior* projects downwards and forwards, rests on the great wing of the sphenoid bone, and is marked internally by the middle artery of the dura mater; it is often exceedingly desirable in the living subject to ascertain the situation of this angle in consequence of its fracture and rupture of the artery causing extravasation of the blood on the brain; it may be always ascertained by drawing a line horizontally backwards, commencing about half an inch above the superciliary ridge of the frontal bone, and then meeting this with a line drawn vertically upwards from the centre, or most prominent part of the zygomatic arch, these two lines will cross on this angle; the *posterior superior angle* fits in between the occipital and the opposite parietal; the *posterior inferior* is cut off, rests on the mastoid portion of the temporal bone, and is grooved internally by the lateral sinus, and may be ascertained in the living subject by drawing a line directly backwards from the zygomatic arch; the angles of the parietal bone are often deficient, and their place supplied by the *ossa triquetra*; these frequently exist in the posterior angles, but seldom in the anterior, particularly in the anterior superior, although this is the last to be ossified, in fact not being completed till some, in a few cases, many years after birth; those that are

not ossified at birth have their places supplied by the external and internal periosteum or dura mater united together and forming the fontanelles. The *circumference* of the parietal bone is sufficiently indicated in the preceding description; in it or near it may be seen foramina for the transmission of vessels, the largest and most constant of these exist near the sagittal suture; its *structure* is the same as all flat bones, it is developed by one point of ossification which appears in the parietal eminence; it articulates with five bones, the *opposite parietal*, the *frontal*, the *sphenoid*, the *temporal*, and the *occipital*. To place it in situ, its smooth convex surface must be turned outwards, its concave inwards, its most prominent angle, the anterior inferior, downwards and forwards, so that its posterior inferior angle is the lowest part of the bone.

The *occipital bone* is an irregularly curved bone, occupying the posterior part, and extending into the base of the cranium, between the parietal bones superiorly, the temporal bones laterally and anteriorly, and the sphenoid directly in front; it is of a diamond shape, and may be divided into two *surfaces*, an *outer* and *inner*, and a *circumference*.

The *outer surface* may be divided into two triangular parts, a superior and inferior, by a projecting ridge of bone, termed the *superior semicircular ridge*, the superior forms the posterior part of the cranium; it is smooth and convex, covered by the cranial aponeurosis, and by the occipito frontalis muscle laterally; it is bounded inferiorly by the superior semicircular ridge which separates it from the inferior part; this ridge, strong and projecting in the centre, where it presents a remarkable eminence, termed the

occipital protuberance, is gradually lost externally towards the mastoid process; it gives origin to the trapezius muscle internally, the occipito-frontalis and sterno-mastoid externally; the inferior portion commences at this ridge, passes forwards and upwards, and forms part of the base of the cranium; it is exceedingly rough and irregular; immediately beneath the ridge is a rough surface which gives attachment to the complexus and splenius muscles; this is bounded anteriorly by the *inferior semicircular ridge* less prominent than the superior, in front of which is a rough surface, into which is implanted the greater and lesser posterior recti muscles, and the obliqui capitis superiores; the surfaces on either side are separated by a ridge of bone, directed downwards and forwards, commencing superiorly at the occipital protuberance, and terminating inferiorly in the foramen magnum, which gives attachment to the ligamentum nuchæ; in front of these is the *foramen magnum* placed nearly horizontally, of an ovoid or oval shape, long from before backwards, larger posteriorly than anteriorly, through which pass the spinal marrow and membranes, the vertebral arteries and spinal accessory nerves; this aperture is larger internally than externally, its outer edge is well defined and has attached to it, the anterior and posterior ligaments anteriorly; its inner, rounded off, gives attachment to the dura mater in its circumference, to the apparatus ligamentosus colli anteriorly; it is bounded laterally near its anterior extremity by the *condyles*; these are two convex articular processes which rest on the first cervical vertebra; they are oblique, their long axis directed forwards and inwards, their aspect is downwards and outwards; they descend

farthest internally, and are here marked near their centre by a depression for the attachment of the check ligaments; in front of these is the *ant-condyloid foramen*, in the bottom of a fossa of the same name, which transmits the lingual or ninth nerve, behind them is the *posterior condyloid foramen*, not always present, which transmits small artery and vein; external to each condyle is the *jugular process* presenting a rough surface, which gives insertion to the recti capitis lateralis muscle; directly in front of the foramen magnum is the *basilar* or *cuneiform process*: this passes upwards and forwards to join the body of the sphenoid bone; it is rough and quadrilateral, and divided on this surface into an anterior and posterior part by a transverse ridge: the anterior part forms the roof of the pharynx, and is covered by mucous membrane; the posterior gives insertion to the greater and lesser anterior recti muscles; into the ridge is implanted the superior and middle constrictors of the pharynx. The *inner* or *cerebral surface* of the occipital bone is concave, irregular, and covered by the dura mater; it is wide and expanded posteriorly, contracted anteriorly; posteriorly it is divided by a *crucial ridge*, into the four occipital fossæ, two superior and two inferior; the two superior rough, and marked by the convolutions of the brain, give lodgement to the posterior lobes of the cerebrum; the two inferior, smooth, to the lateral lobes of the cerebellum; the superior vertical portion of the ridge gives attachment to the falx cerebri, and is grooved for the longitudinal sinus; occasionally the groove is to one side, most frequently to the right of the ridge; the inferior portion gives attachment to the falx cerebelli; it is

grooved superiorly for the posterior occipital sinuses, and bifurcates inferiorly to surround the foramen magnum; the transverse portion of the ridge, inclining on either side a little downwards, gives attachment to the tentorium cerebelli, and is grooved for the lateral sinuses; the vertical and transverse portions cross in the *internal occipital protuberance* which corresponds to a similar eminence on the outer surface of the bone; on it, or on one side of it, most frequently the right, rests the *torcular-herophili*; in front of these is the inner circumference of the foramen magnum: this is larger than the external, and is rounded off; towards its anterior part is the internal opening of the anterior condyloid foramen, sometimes double; on each side of it the bone is grooved deeply by the lateral sinus, and presents here the internal extremity of the posterior condyloid foramen; in front of the foramen magnum is the inner surface of the basilar process, sometimes called the basilar gutter; this is concave from side to side, and supports the pons-Varolii, the basilar artery, and the sixth pair of nerves; it is crossed by the transverse occipital sinuses, and is slightly grooved laterally for the inferior petrosal sinus. The *circumference* of the occipital bone is exceedingly irregular: we commence at its superior posterior angle; this is frequently completed by an os triquetrum, and is received between the parietal bones; passing laterally from this the bone is serrated superiorly, and joins the parietal bones, forming the *lambdoidal suture*; inferiorly it is rough, but not serrated; it here joins the mastoid part of the temporal, and forms the *additamentum suturæ lambdoidalis*; descending from

this we meet with the jugular process, it then becomes smooth and excavated, and forms with the petrous portion of the temporal bone the *foramen lacerum posterius*; this is directed forwards and inwards, parallel to the condyles; it is ovoid in shape, and is divided into a posterior and anterior part by a ridge of bone or cartilage; the posterior, which is also internal is the larger, and transmits the jugular vein and the posterior meningeal arteries; the anterior smaller and internal transmits the eighth pair of nerves; in front of this is the lateral surface of the basilar process, joined to the petrous portion of the temporal bone, and forming with it the groove, for the inferior petrosal sinus; directly in front, the basilar process joins the body of the sphenoid: in this situation the two bones are united at the adult period of life; hence some anatomists have described them as one, under the name of the spheno-occipital bone. The *processes* of the occipital bone are five in number: two condyles, two jugular processes, and the basilar or cuneiform process; its *foramina* are five proper, and two common; the proper are the foramen magnum, the two anterior and the two posterior condyloid; the common are the two posterior foramina lacera in basi cranii. The occipital articulates with six bones: the two parietal, the two temporal, the sphenoid, and the first cervical vertebra; its structure is the same as all flat bones; it is exceedingly strong and resisting, owing to the different ridges formed on it and the density of its compact tissue; in some situations it is transparent; it is developed by four points of ossification, one for each condyle, one for the basilar process, and one for the posterior

occipital protuberance. To place it in situ its convex surface must be turned backwards and downwards; its concave forwards and upwards; the basilar process forwards and upwards, and the foramen magnum nearly horizontally.

The *Temporal bones* are two in number, and are placed in the central, lateral, and inferior parts of the head, between the occipital posteriorly, the sphenoid anteriorly, the parietals superiorly; they are exceedingly irregular, and contain in their interior the internal organs of hearing—each may be divided for the purpose of description into three portions: the *squamous*, *mastoid*, and *petrous*. The *squamous portion* of the temporal bone occupies its external and anterior part; it is thin, flat, and semi-circular; its *outer surface* is smooth and convex, and is marked by arterial ramifications; from its inferior part arises a projecting portion of bone, termed the *zygomatic process*; this commences posteriorly by two roots: the *horizontal* and *transverse*; the *horizontal* root itself has a double origin, a superior which proceeds from the surface of the bone, and is continuous with the ridge on the parietal bone, for giving origin to the temporal aponeurosis; the other, inferior, passes downwards and inwards, and terminates in the Glaserian fissure; between these origins is placed the meatus auditorius externus, the transverse root passes almost directly inwards, but descends a little backwards, is convex from before backwards, concave from side to side, is encrusted with cartilage, bounds the glenoid cavity in front, and articulates with the inferior maxilla; from its external extremity descends a small tubercle, which gives attachment to the external lateral

ligament of the tempero-maxillary articulation ; from these origins the zygomatic process passes forwards and outwards, then turns a little inwards, and terminates anteriorly in a serrated edge, cut off, first downwards, then obliquely downwards and backwards, which articulates with a similar process of the malar bone, forming the zygomatic arch, the outer surface of the zygoma is convex and subcutaneous, except at its posterior part, where it is crossed by the temporal artery ; its inner is concave, corresponds to the temporal, and gives origin to the masseter muscle. its upper edge presents a deep groove, posteriorly, along which glide the fibres of the temporal muscle : anteriorly it is thin and sharp, and gives attachment to the temporal aponeurosis, its inferior edge, much less extensive than the superior, is thick, and gives origin, as well as the inner surface, to the masseter muscle ; behind the transverse root of the zygoma is the *glenoid cavity* ; this is concave, elongated obliquely backwards and inwards, and is bounded anteriorly by the transverse root of the zygoma, posteriorly by the meatus auditorius externus, internally by the spinous process of the sphenoid, externally by the horizontal root of the zygoma ; it is divided into an anterior articular, and a posterior non-articular portion by the *Glaserian fissure*, the anterior larger is deeply excavated, covered by cartilage, and articulates with the inferior maxilla, the posterior, smaller gives lodgement to a part of the parotid gland, the *Glaserian fissure* passes forwards and inwards, is better marked internally than externally, transmits the tendon of the laxator tympani muscle and some small arteries to the tympanum, the chorda tympani nerve passes out through it, and from it arises the capsular ligament

of the tempero maxillary articulation; behind the glenoid cavity is the *external auditory foramen*; this is a large, nearly circular, foramen, placed between the two origins of the horizontal root of the zygoma, bounded superiorly by the squamous portion, inferiorly by a semicircular rough process of bone, which commences posteriorly at the mastoid process, and terminates anteriorly in the Glaserian fissure, and gives attachment to the cartilage of the meatus auditorius; this foramen leads into the *meatus auditorius externus*, a canal which leads to the cavity of the tympanum, but is separated from it by the *membrana tympani*, it passes from the external aperture downwards, forwards, and inwards, is curved, the convexity directed upwards, longer inferiorly than superiorly, smaller in the centre than the extremities, and is covered by a prolongation of the skin; it is about nine or ten lines in length, in the fœtus it is formed by a distinct ring of bone, and is only a few lines in length. The inner or cerebral surface of the squamous portion is smaller than the external, is concave and irregular, and marked by the convolutions of the brain, and by arterial ramifications, branches of the middle meningeal artery; superiorly it is cut off obliquely upwards and outwards, overlaps the parietal bone, and forms the squamous suture; inferiorly it joins the petrous portion of the bone. The *mastoid portion* of the temporal bone is placed behind the squamous in the posterior and inferior part of the bone, and has received its name from a projecting eminence descending from its inferior and external part, termed the *mastoid process*, this is a conical nipple-like eminence, directed downwards and forwards, convex and irregular externally for

the insertion of the sterno-mastoid muscle, internally it is nearly plane and smooth, and presents at its base a deep groove, which lodges the digastric muscle, hence called the *digastric groove*, internal and posterior to this is a superficial groove for the insertion of the trachelo-mastoideus, behind it is a rough surface, into which the muscle is inserted, together with the splenius and lesser complexus, and behind this again is the *mastoid foramen*, which transmits a vein into the lateral sinus—it is sometimes wanting. In advanced life the mastoid process is remarkably prominent, and is hollowed out into the mastoid cells which communicate with the tympanum; in the very young subject it hardly exists; internally this portion of the temporal bone presents a deep groove for the lateral sinus, in which is the internal extremity of the mastoid foramen. The *petrous portion* of the temporal bone occupies its internal part, and proceeds from the inner surface of the squamous and mastoid portions forwards and inwards towards the sphenoid bone; it is of a pyramidal shape, the base directed backwards and outwards where it joins the rest of the bone, its apex, turned forwards and inwards towards the sphenoid bone, is free; it has received its name from the stony hardness of its structure, in it is contained the internal organs of hearing; it may be divided into three *surfaces*, a *superior*, *posterior*, and *inferior*, separated by as many edges, a *posterior*, *inferior*, and *anterior*; the *superior surface* forms part of the middle fossæ of the cranium, for lodging the middle lobes of the brain; the convolutions of which give it an irregular appearance; near its anterior extremity or apex is a smooth concave surface, over

which passes the fifth pair of nerves, and on which rests the Casserian ganglion; in the centre is a foramen which terminates a groove directed backwards and outwards: this is the *Hiatus Fallopii* through which the vidian nerve passes to the aqueduct of Fallopius, accompanied by a small artery; external and posterior to this is a remarkable eminence projecting above the rest of the bone, and formed by the superior semicircular canal; this surface is separated from the posterior by the superior edge; this gives attachment to the convex margin of the tentorium cerebelli, and is grooved for the superior petrosal sinus, except anteriorly, where it is smooth for the passage of the fifth nerve, which here separates this sinus from the bone. The *posterior surface*, directed backwards, is also irregular; near its anterior extremity, and at the junction of about its middle and internal thirds, is a large foramen, perforating the bone obliquely, directed forwards and outwards, having its edge rounded off; this is the *internal auditory foramen* through which passes out the seventh pair of nerves. On looking into the bottom of its cavity, there may be seen a cribriform plate, and a single foramen placed above it; through the plate passes the portio mollis, to supply the cochlea, vestibule, and semicircular canals; through the foramen the portio-dura enters the aqueduct of Fallopius. Behind the internal auditory foramen is an irregular cleft, into which the dura mater is attached, and still more posteriorly a narrow triangular fissure, which is the termination of the *aqueduct of the Vestibule*; from this descends to the jugular fossa a tolerably well-marked groove; this surface is separated from the inferior by the *inferior*

edge ; the anterior extremity of this is rounded off to form with the basilar process of the occipital bone a groove for the inferior petrosal sinus ; behind this, and immediately beneath the internal auditory foramen is a triangular aperture, the external opening of the *aqueduct of the Cochlea* ; behind this is the jugular fossa forming with the occipital bone, the foramen lacerum posterius, as described with the occipital bone ; posterior to this, this edge joins the mastoid portion of the temporal bone. The *inferior surface* of the temporal bone is the most irregular, and forms part of the base of the cranium ; on it we may perceive, passing from before backwards, a rough surface which affords origin to the circumflexus palati and levator palati muscles ; a large foramen, the external orifice of the *Carotid canal* which transmits the carotid artery ; this canal first passes upwards, then forwards and inwards, and terminates in the apex of the petrous portion ; a deep depression, termed the jugular fossa, produced by the regurgitation of the blood in the vein of the same name ; a quadrilateral surface covered by cartilage which articulates with the jugular process of the occipital bone ; externally this is bounded by a small foramen termed the *stylo-mastoid foramen* ; this is the termination of the aqueduct of Fallopius, and transmits the portio-dura nerve ; this foramen is bounded anteriorly, and a little to its inner side, by the *styloid process* ; this is a long slender process of bone directed forwards and inwards, and terminating inferiorly in a point ; it gives origin to the stylo-hyoid, stylo-pharyngeus, and stylo-glossus muscles, and the stylo-maxillary and stylo-hyoid ligaments ; in the old subject this is particularly well marked,

but in the young subject it is connected to the rest of the bone by cartilage, whence it is seldom seen in the separated bones; it is surrounded at its root by a bony plate, termed the *vaginal process*; the stylo-mastoid foramen is bounded externally by the mastoid process, and is directly on a line with its anterior margin, but about half an inch internal to it; this surface of the petrous portion of the temporal bone is separated from the superior *by the anterior edge*: this is of very short extent; it presents externally a retreating angle formed with the squamous portion which receives the spinous process of the sphenoid bone, at the bottom of it may be seen an irregular foramen divided into two, a superior and inferior, by a thin bony plate: the superior is the smaller, and transmits the tendon of the tensor tympani muscle; the inferior larger, forms the bony portion of the Eustachian tube. By the junction of these surfaces and edges anteriorly, the summit of the petrous portion is formed; it is cut off obliquely, presents the termination of the carotid canal, and forms the *foramen lacerum anterius* along with the body of the sphenoid, which foramen it separates from the *foramen lacerum posterius*; this foramen is nearly closed up by cartilage, the vidian nerve and carotid artery cross it, some branches of the anterior meningeal artery pass up through it, and the Eustachian tube corresponds to it inferiorly.

The *circumference* of the temporal bone is exceedingly irregular, commencing at the retreating angle, formed by the junction of the petrous and squamous portions; it here receives the spinous process of the sphenoid bone; from this it passes upwards and forwards on the squamous portion; it is here thick

and cut off on its outer surface inferiorly, its inner surface superiorly, to articulate with the great wing of the sphenoid; from this it becomes thin, is cut off considerably on its inner surface, to form with the parietal bone, the squamous suture; passing backwards to the mastoid portion it becomes again thick, supports the posterior inferior angle of the parietal bone forming the *additamentum suturæ squamosæ*; from this it descends forwards, is thick, and articulates with the occipital bone; arrived at the inferior edge of the petrous portion, it becomes smooth, thin, and excavated, forming the foramen lacerum posterius, in which it presents the opening of the aqueduct of the cochlea; immediately in front of this it is smoothed off to form, with the cuneiform process of the occipital bone, the groove for the inferior petrosal sinus; arriving now at the summit of the bone, we observe the termination of the carotid canal; then the inferior edge of the bone, presenting the double foramen for the tensor tympani muscle, and the Eustachian tube.

The temporal bone contains, in its interior, the aqueduct of Fallopius, the semicircular canals, cochlea, vestibule, bones of the ear, etc., all of which will be described in the organs of hearing; its processes are five in number, the zygomatic, the mastoid, the jugular, the styloid, and the vaginal; its foramina are ten proper, and two common; the proper are the Hiatus Fallopü, the internal auditory foramen, the openings of the aqueducts of the cochlea and vestibule; the mastoid foramen, the external auditory foramen, the stylo-mastoid, the carotid, the Glasserian fissure, and the double foramen for the tensor tympani muscle and Eustachian

tube ; the common are, the foramen lacerum anterius, and posterius ; it articulates with five bones, the parietal, the occipital, the sphenoid, the malar, and the inferior maxillary ; its structure is in the petrous portion very dense and compact, especially where it forms the internal parts of the organ of hearing ; its squamous portion is chiefly compact with a little spongy tissue in its circumference ; its mastoid process is spongy, and contains, in the old subject, numerous cells which communicate with the tympanum. In the foetus the petrous portion is well developed and distinct from the squamous ; the bones of the ear, too, are well formed. It is developed from six points of ossification, one each for the squamous, mastoid, and petrous portions ; the circumference of the meatus auditorius externus, the zygomatic process, and the styloid process ; when placed *in situ* its petrous portion is directed forwards, and inwards, the external auditory foramen outwards, and the zygomatic process horizontally forwards.

The *Sphenoid* is an exceedingly irregular shaped bone, resembling somewhat a bat with its wings expanded, placed nearly in the centre of the head, forming part of its lateral parieties, and descending inferiorly into the base of the skull ; it is placed so as to articulate with all the bones of the cranium, and most of those of the face, between which it appears to be wedged in, whence it has received its name ; it may be divided into its *body*, *wings*, and *processes*. The *body* of the sphenoid bone is placed directly in the centre ; it is irregular, and has attached to either side the greater and lesser wings, it may be divided into a *superior*, or *cerebral surface*, a *posterior surface*, an *anterior* or *nasal surface*. The

superior or *cerebral* surface is situated in the interior of the cranium ; in it we perceive, as we pass from before backwards, a quadrilateral, projecting, thin plate of bone, the *ethmoid process*, which fits into the ethmoidal notch of the frontal bone, and articulates with the cribriform plate of the ethmoid ; a smooth surface, over which pass the olfactory nerves ; behind this is a superficial depression, the *olivary process*, on which rests the commissure of the optic nerves, bounded on each side by a nearly circular foramen, directed forwards and outwards, the *optic foramen*, which transmits the optic nerve and ophthalmic artery ; posterior to this is a deep depression, termed the *Sella Turcica* ; this is quadrilateral, forms the roof of the sphenoidal sinuses, and is perforated by several small foramina, through which pass vessels from the dura mater, to the Schneiderian membrane ; it is covered by the dura mater, here not lined by the arachnoid membrane, and gives lodgement to the pituitary gland, and the transverse and circular sinuses of the sella turcica ; it is bounded in front and behind by the four *clinoid processes*, two *anterior* and two *posterior* ; the anterior clinoid processes, one on each side, project considerably backwards and inwards, are thick, and give attachment to the concave margin of the tentorium cerebelli ; the *posterior* are less distinct, are in general united to one another, and sometimes to the anterior ; they give attachment to the convex margin of the tentorium ; laterally the sella turcica is grooved by the passage of the carotid artery ; behind the posterior clinoid processes is a descending part of the bone, the *clivus* ; the *posterior surface* is rough and irregular, looks downwards, and backwards, and joins the basilar process of the occipital

bone, to which it is united in adult life ; the *anterior* or *nasal surface* is directed downwards and forwards ; on it we perceive, on the mesial line, an irregular projection, termed the *azygos process*, or *rostrum*, which is received between the laminæ of the vomer inferiorly, and articulates with the nasal lamella of the ethmoid superiorly ; it is continuous with the septum of the sinuses ; on each side is a slight drain which receives the edge of the laminæ of the vomer, and on each side of, and a little below it, is a groove which assists in forming the pterygo-palatine canal ; above the groove on this surface of the bones are the *openings* of the *sphenoid sinuses* ; these are nearly closed up by two triangular bones, termed the bones of Bertin, or the sphenoidal cornua ; beyond these openings are rough surfaces which articulate with the ethmoid and palate bones ; the body of the sphenoid bone is hollowed out into two large cavities, termed the *sphenoidal sinuses*, these are separated by a thin septum, continuous with the azygos process, which divides them unequally ; the right being, in general, larger than the left ; it is sometimes imperfect ; in the interior of the sinuses may be perceived irregular projections of the bone ; they are lined by mucous membrane, and open into the superior meatus narium ; they hardly exist in the young subject, are very large, and extend into the lesser wings in advanced life. The *wings* of the sphenoid bone are four in number, two on each side, they are called the *lesser* and *greater wings*, the *lesser wings*, or the *wings of Ingrassias* are situated, one on each side, in the cerebral surface of the bone, being connected to the lateral surface of the body, in front of the sella turcica, from which they stretch out transversely ; each is triangular in shape, the base

internally, the apex externally, where it terminates in an exceedingly thin point which articulates with the frontal bone; its anterior edge is rough, and rests on the orbital plate of the frontal bone; its posterior edge is thin, smooth, and concave; gives attachment to the sphenoidal fold of the dura mater; and corresponds to the fissure of Sylvius; its internal extremity terminates in the anterior clinoid process; its upper surface, smooth and convex, supports the anterior lobes of the brain; its under forms the greater part of the foramen lacerum orbitale. The *great wing* is situated to the outer side of the lesser; extends from the side of the body upwards, forwards, and outwards, and forms the whole of the lateral mass of the sphenoid bone; it is somewhat triangular in shape, and may be divided into three surfaces, a *posterior*, *anterior*, and *external*. The *posterior* or *cerebral* surface forms part of the middle fossa of the cranium, giving lodgement to the middle lobes of the brain; it is concave, and marked by the convolutions of the brain, and branches of the middle meningeal artery; in it we perceive, as we pass backwards and outwards, the *foramen lacerum orbitale* formed between its edge and the lesser wing, and a little externally by the frontal bone; this foramen is irregular in shape, elongated forwards and outwards, larger internally than externally, and closed up to a great extent by the dura mater; it transmits into the orbit the third, fourth, the first division of the fifth and sixth nerves, and one of the origins of the external rectus muscle; through it passes backwards the ophthalmic vein, to empty itself into the cavernous sinus; the *foramen rotundum*, immediately beneath the internal extremity of the former, directed forwards and outwards, and

transmitting the second division of the fifth nerve; internal to this is a concave surface, which lodges the cavernous sinus; passing still more backwards and outwards is the *forameno vae* situated external and posterior to the preceding, much larger, directed downwards, which transmits the third division of the fifth nerve—the *spinous process*, a narrow pointed process, directed downwards and outwards, which fits into the retreating angle of the temporal bone; this is pierced by a small foramen, the *spinous foramen*, which transmits the middle meningeal artery; from it projects, inferiorly, the *styloid process*, which gives attachment to the internal lateral ligament of the temporo-maxillary articulation. The *anterior* or *orbital* surface is the smallest of the three, is directed forwards and inwards, concave, smooth, and quadrilateral, and forms part of the outer wall of the orbit; its superior edge articulates with the frontal bone; its anterior with the malar; its posterior is free, and forms part of the foramen lacerum orbitale, as is also its inferior, which is smooth, rounded off, and forms part of the spheno-maxillary fissure. The *external* or *temporal surface* of the great wing, directed downwards and outwards, elongated from above downwards, appears in the lateral part of the cranium; it is concave and divided into two parts, a superior or temporal, and an inferior or zygomatic, by a nearly transverse ridge of bone, better marked in the old than in the young subject; the temporal surface is the larger, forms part of the temporal fossa, and gives origin to the muscle of the same name; the zygomatic surface, smaller, turned downwards, forms part of the zygomatic fossa, and gives origin to the external pterygoid muscle; to the ridge is attached

a few fibres of the temporal muscle. From the *inferior* part of the great wings, and also from the body, descend the two *pterygoid processes*, the *internal* and the *external*; these processes are distinct posteriorly, being separated by an interval termed the *pterygoid fossa*; they are united anteriorly, except at the lowest part, where a triangular excavation exists, in which is lodged the tuberosity of the palate bone; the *internal pterygoid process* is longer, but narrower, than the external; its inner surface is smooth and concave, and forms the external boundary of the posterior nares; its outer surface, also concave, forms part of the pterygoid fossa; its posterior edge, thin and sharp, gives attachment to the circumflexus or tensor palati muscle, it commences superiorly by a depression, termed the *fossa navicularis*, from which also arises this muscle; inferiorly it terminates in the *hamular process*, a bony hook, curved downwards, backwards, and outwards, convex internally, round which the tendon of the tensor palati muscle plays, lined by a synovial sac, and which gives origin to the superior constrictor of the pharynx; the *external pterygoid process*, shorter, but broader, than the internal, is twisted outwards from it; its outer surface, irregularly concave, forms part of the zygomatic fossa, and gives origin to the external pterygoid muscle; its inner, concave also, forms part of the pterygoid fossa, and gives origin to the internal pterygoid muscle; anteriorly the two pterygoid plates are united superiorly, and articulate with the palate bone; inferiorly they are separated by a triangular interval, in which is lodged the tuberosity of this bone; posteriorly they are separated, in consequence of the divergence of the external

pterygoid plate, by a considerable interval, larger below than above, termed the *pterygoid fossa*, which lodges the origin of the internal pterygoid muscle; close to the root of these processes, on the anterior surface of the bone, a little below and internal to the foramen rotundum, is a round foramen, termed the *vidian foramen*; this leads into the vidian canal, which terminates posteriorly in the foramen lacerum anterius, by a triangular opening, smaller than the anterior, and situated internal to the foramen ovale; it transmits the vidian nerve and a few vessels which accompany it.

The *circumference* of the sphenoid bone is exceedingly irregular, commencing at the ethmoid process; it is here thin and sharp, and articulates with the cribriform plate of the ethmoid bone; from this we pass along the anterior edge of the lesser wing, which is cut off obliquely to articulate with, and rest on, the orbital plate of the frontal bone; passing outwards we cross the extremity of the *foramen lacerum orbitale* to the upper extremity of the great wing; it here presents a large triangular rough surface which supports the frontal bone in front: the anterior inferior angle of the parietal bone behind; descending from this anteriorly it presents the anterior margin of the orbital plate, rough for articulation with the malar bone, and terminating in the smooth edge, which forms the spheno-maxillary fissure; descending posteriorly along the great wing it is concave, thin, and cut off on its outer surface superiorly; thick, and cut off in its inner surface inferiorly; to articulate with the squamous portion of the temporal bone, it terminates in the spinous process which is received into the retreating angle of this bone; passing from this forwards and inwards it assists in forming the *foramen*

Vomer *anterior*; passing directly inwards we meet with the rough surface, by which it joins the basilar process of the occipital bone; then ascending forwards along the mesial line, on the under surface of the body, we meet with the azygos process, which articulates with the vomer; on either side of this it articulates, as already indicated, with the sphenoidal cornua and the palate bone; besides this the anterior surface of the pterygoid plates articulates with the ascending portion of the palate bone; the sphenoid and superior maxillary bones seldom articulate, being separated by the palate bone. The *structure* of the sphenoid bone is chiefly compact; it contains, however, cellular tissue in the great wings in the anterior clinoid processes, which are sometimes even hollowed out into cells, in the root of the pterygoid processes, and in the body, before the sinuses are formed; it articulates with the frontal, the ethmoid, occipital, parietal, and temporal bones, the sphenoidal cornua, malar, palate bones, and vomer, and sometimes with the superior maxillary bones. It is developed from seven points of ossification, which commence in the body, the lesser wings, the roots of the pterygoid processes, and, in the internal pterygoid process; in the fœtus it is divided into an anterior, or spheno-orbital, and a posterior, or spheno-temporal portion. The *processes* of the sphenoid are seventeen in number:—one ethmoidal; one olivary; four clinoid; one azygos; two spinous; two styloid; four pterygoid and two hamular; some anatomists enumerate a much greater number, considering the wings, etc., as processes. The *foramina* are twelve *proper*, and four *common*; the proper are two optic, two round, two oval, two spinous, two vidian,

and the two openings of the sinuses; the common are, two foramina lacera orbitalia, two foramina lacera anteriora in basi cranii; besides these, the sphenoid bone forms part of the *spheno-maxillary fissure*; this is a cleft, or fissure, situated in the posterior and external part of the orbit, and is formed by the sphenoid, malar, superior maxillary, and palate bones, although called spheno-maxillary; the internal maxillary artery terminates here, and the superior maxillary nerve crosses it; its cornua to be afterwards described, assist in forming the two spheno-palatine foramina in each of which Meckel's ganglion is lodged, and its pterygoid plates form, with the palate-bone, the pterygo-palatine canals. To place it *in situ* the sella turcica must be directed upwards, the pterygoid processes downwards, and the azygos process downwards and forwards.

Connected with the sphenoid bone are two thin plates of bone termed the *bones of Bertin*, or the *sphenoidal cornua*; they are placed one on each side of the azygos process, in front of, and nearly closing up, the sphenoidal sinuses; each is a little curved on itself, is pyramidal in shape; the apex, turned backwards, is received into a groove near the root of the pterygoid processes; its base is applied against the lateral masses of the ethmoid bone, and closes up the posterior ethmoidal cells, although sometimes it allows of a communication between them and the sphenoidal sinuses; its inferior surface forms part of the nasal fossæ, and sends a production forwards which passes inwards and joins the vomer; its external surface, superiorly, bounds the opening of the sphenoidal sinuses, inferiorly completes the spheno-palatine foramen; it articulates with the

sphenoid, ethmoid, vomer, and palatine bones ; its structure is chiefly compact ; the apex contains a little spongy tissue ; it is developed by a single point of ossification, which, in general, appears after birth ; in the adult period of life they become united to both the sphenoid and ethmoid bones, but to the former first ; when placed in situ the apex is turned backwards, the base forwards and upwards.

The *Ethmoid bone* is placed in the anterior inferior part of the cranium on the mesial line, filling up the ethmoid notch in the frontal bone, between the cavity of the cranium above, the nares below, and the orbits on either side ; it is somewhat cubical in shape, and is composed chiefly of an assemblage of thin delicate bones, arranged in a very irregular manner, and forming numerous cells ; it is the lightest and smallest of the bones of the cranium ; it may be divided into a *superior* or *cerebral*, and an *inferior* or *nasal surface*, and seems to consist of a *horizontal* and *vertical plate*, and two *lateral masses* ; the *superior* or *cerebral surface* presents the horizontal plate of the ethmoid bone, which has received the name of the *cribriform plate*, and has given to this bone, the name of ethmoid, from its sieve-like appearance ; it occupies the superior part of the bone, and forms part of the cavity of the cranium superiorly ; the nasal cavity inferiorly ; it is thin and quadrilateral ; its *superior* or *cerebral surface* presents, on the mesial line, nearer its anterior than posterior part, a remarkable eminence, the *crista galli* ; this forms part of the vertical plate, being continuous inferiorly with the nasal lamella ; it is variable in size and direction, is triangular in shape ; its apex is free, and gives attachment to the falx cerebri ; its base is continuous with the cribriform plate and nasal lamella ; its posterior edge

is the longest, and slopes downwards and backwards ; its anterior is the shortest, and descends vertically ; this presents, near its inferior part, two projecting cornua, which unite with the frontal bone to form the *foramen cæcum*, and is occasionally hollowed into cells which join those of the frontal bone ; on either side of this is a channel or groove, deeper and narrower anteriorly than posteriorly, for lodging the olfactory nerves, perforated by numerous foramina for the transmission of these nerves ; they are more numerous anteriorly, and are divided into three sets, an internal, external, and middle ; the two former, more numerous, lead to canals which terminate inferiorly in the substance of the bone, the latter are true holes, and appear in the roof the nasal fossa ; at the anterior part of this surface, close to the base of the crista galli is a small longitudinal slit on each side, which transmits the nasal branch of the ophthalmic of the fifth nerve ; *inferiorly* the cribriform plate presents the nasal lamella, on the mesial line ; on each side of this, the middle set of foramina, and laterally forms the roof of the ethmoid cells : its posterior edge is frequently deficient, leaving part of the cells uncovered, and articulates with the ethmoid process of the sphenoid ; laterally it is also deficient, and is overlapped by the orbital plates of the frontal bone which thus close up the cells in this direction ; in this edge may be seen two grooves which unite with the frontal bone, to form the foramen commune anterius, and posterius ; anteriorly the cribriform plate unites with the frontal bone. The *inferior* or *nasal surface* presents the *vertical plate*, or *nasal lamella* of the ethmoid bone ; on either side of this a deep channel which forms part of the roof of the nose, and to its outer side the lateral masses or *labyrinths* ; the *vertical* or *nasal*

laniella, is situated on the mesial line, inclining frequently to one side, it may be seen to descend nearly perpendicularly from the under surface of the cribriform plate, where it is continuous superiorly with the crista galli, it is somewhat quadrilateral, but is variable as to size, shape, etc., and enters into the formation of the septum narium; the *circumference* is irregular; posteriorly it is thin and articulates with the septum of the sphenoidal sinuses: inferiorly it is also thin where it is received between the laminæ of the vomer, anteriorly it is thick above where it articulates with the nasal spine of the frontal, and the nasal bones, below it is also thick, sometimes grooved, and joins the nasal cartilage; its *surfaces* are covered by mucous membrane, and are marked by grooves much deeper superiorly than inferiorly; short and oblique in front, long and vertical in the centre, very long and inclined backwards posteriorly; they terminate about the centre of the plate, and lodge the olfactory nerves and some vessels; on each side of this plate is a deep channel, narrow from side to side, long from before backwards, bounded above by the cribriform plate, which forms the roof of the nose, in it may be seen the middle set of foramina for the olfactory nerves, and the anterior slit-like aperture for the nasal nerve; on the outer side of this are the *lateral masses* of the ethmoid bone; these are also called the *labyrinths*, and consist, each, from within outwards, of the two *spongy bones*, the *cells* and the *os planum*. The two *spongy* or *turbinated bones* are the *superior* and *inferior* of the ethmoid bone, the *superior* and *middle* of the nose; they consist each of a thin rough plate of bone twisted on itself from above downwards, and from within outwards, convex internally,

concave externally; the *superior* is the smaller, and is sometimes double, it is bounded in front by a quadrilateral plate of bone, which joins it to the inferior; beneath it, and above the inferior, is a channel or groove occupying the posterior half of the bone, and which slopes downwards and backwards, this is the *superior meatus narium*, into it open the posterior ethmoid cells, the sphenoidal sinuses, and the sphenopalatine foramen; the *inferior*, larger than the other, is rougher and more twisted on itself, anteriorly it is small and thin and connected to the rest of the bone, posteriorly it is rough, free, and irregular; beneath it is another channel, longer than that first described, and complete from before backwards, this is the *middle meatus narium*, into it open the anterior ethmoid cells, the frontal sinuses, and antrum Highmorianum. The spongy bones are covered by mucous membrane, and are marked by grooves on their convex surfaces, for the distribution of the olfactory nerves. The *ethmoid cells* occupy the centre of the lateral masses between the spongy bone internally, and the os planum externally; they consist of numerous cells, variable as to number, formed by irregular plates of bone, and are divided into the *anterior* and *posterior* by a bony septum; of these the posterior, smaller and less numerous, vary in number from four to ten, and open into the superior meatus; posteriorly they are completed by a thin plate of bone, or by the bone of Bertin, and even sometimes communicate with the sphenoidal sinuses; the *anterior*, larger and more numerous, open into the anterior part of the middle meatus; one of these, placed posterior to the others, forms a winding canal, which communicates with the frontal sinuses, is called the *infundilulum*, and is the

common opening of these cells, and the frontal sinuses into the middle meatus; these sinuses are lined by mucous membrane, continuous with that investing the nasal cavity, but is much thinner, more delicate, smoother, and less vascular; the use of these cells is not yet decided on, they are, by some, conceived to increase the surface for the sense of smell; they are not perfect in the separate bones; superiorly they are bounded by the cribriform plate, laterally and superiorly by the frontal bone; externally by the os unguis in front, the os planum behind, anteriorly by the superior maxillary and frontal bones, posteriorly by the sphenoid, the sphenoidal cornua and palate bone; inferiorly, the ethmoid bone sends down small, thin, irregular curved plates of bone, which join the superior maxillary, and assist in closing up the opening of its sinus; some join the inferior spongy bone of the nose. The *os planum* or *orbital plate* of the ethmoid bone is situated to the outer side of the ethmoidal cells, being more closely related to the posterior; it assists in closing them up in this direction; it is exceedingly smooth and polished—hence its name, and forms part of the inner wall of the orbit; it is quadrilateral, long from before backwards; anteriorly it articulates with the os unguis, posteriorly with the sphenoid bone, inferiorly with the superior maxillary and palate bone, superiorly with the frontal bone, with which it forms the foramen commune anterius and posterius. The *circumference* of the ethmoid bone is exceedingly irregular; its cribriform plate articulates in front, and at the sides, with the frontal, posteriorly with the sphenoid; its nasal lamella articulates in front with the nasal spine of the

frontal and nasal bones above, the triangular cartilage below, inferiorly with the vomer; posteriorly with the sphenoid; laterally the labyrinth articulates with the frontal, the os unguis, and superior maxillary bones, posteriorly, with the palate, and sphenoid bones, and sphenoidal cornua as just indicated; inferiorly it sends down processes to articulate with the superior maxillary and inferior spongy bones; its *structure* is chiefly compact, except in the spongy or turbinated bones, and crista galli, which contain spongy tissue; it articulates with two bones of the cranium, the frontal and the sphenoid, and with eleven of the face—two nasal bones, two superior maxillary bones, two ossa unguis, two palate bones, two inferior spongy bones, and the vomer; its processes are the crista galli, the nasal lamella, those already mentioned as united to the superior maxillary and inferior spongy bones, and two which assist in forming the foramen cœcum; its proper foramina are those of the cribriform plate; its common are the foramen cœcum and the foramen commune anterius, and posterius; it is developed by three points of ossification, one for its centre, and one for each lateral mass; the spongy bones do not appear till about the age of seven years; its cells do not exist in the very young subject; to place it in situ, its cribriform plate must be placed horizontally, the crista galli directed upwards and towards the frontal bone, its nasal lamella downwards.

In different parts of the cranium may be seen small bones which have received the name of *ossa wormiana*, or *Triquetra*; they are exceedingly irregular as to size, shape, existence, situation, etc.; they are more frequent in the posterior than the anterior part of

the cranium: the largest and the most frequent, perhaps, occupies the superior angle of the occipital bone, where it is received between the two parietals: numerous small ones may be observed in the lambdoidal suture, and in the additamentum suturæ squamosæ; some are long and narrow, others nearly circular; they also exist in the anterior inferior, and the anterior superior angles of the parietal bone, but are not frequent in the latter situation, but few have been seen in the base of the cranium; on the outer surface they are convex, and larger than on the inner; the inner surface is smoother and concave; sometimes, on the contrary, they exist only on the inner surface of the cranium; their circumference is exceedingly serrated externally, not so internally; their structure is the same as that of the bones of the cranium; they seem to be formed in those places where an arrest of development has occurred in the regular bones of the cranium; their use seems to be to connect the bones more firmly together, and to fill up spaces that would otherwise exist. They are of little practical importance, except that they sometimes project externally, and may be mistaken for exostosis, and that an individual, not aware of their existence, might mistake them for fractures of the cranium.

The bones of the cranium belong to the class of flat bones; although the term flat can hardly be well applied to the temporal, sphenoid, and ethmoid bones, still, from their assisting to form a cavity, and from their general structure, (with the exception, perhaps, of the ethmoid,) and, from the effects of disease on them, we may class them amongst flat bones; in the *young subject* the *diplœ* does not exist, the bones are much more vascular, the membranes

adhere more intimately to them, the sutures are not as yet formed, their circumference is not serrated, they are divided into several portions, are thicker in the centre, and present a radiated appearance from the progress of ossification : in the old subject the diplöe disappears, the sutures are firmly connected, and they participate in the changes which all bones undergo at this period of life. The non-existence of the diplöe in the young and old subjects must be recollected in the operation of trephining, else the operator may (expecting to meet with the little resistance it gives to the instrument) perforate the cranium unawares ; in the diplöe may be traced the course of the vessels, particularly of the veins of the bones, by filing off the external table ; the internal table is exceedingly brittle, hence its name of vitreous table, and hence it is so frequently fractured to a much greater extent than the outer. Cases are on record where this table alone has been fractured.

The bones of the cranium are connected together by a species of articulation termed *suture*, which is peculiar to the head ; of this we have two kinds in the cranium, the *serrated* or *denticulated* and the *squamous* ; the former is the more frequent, and is where bony processes or *serræ* pass across from one bone to another, and are firmly interlocked ; the *serræ* are sometimes triangular and pointed, sometimes quadrilateral, and sometimes larger at the free than the attached extremity ; by these means the bones are so connected that no motion is permitted, and that violence applied to them will rather cause a fracture than their separation ; the examination of these *serræ* is exceedingly interesting, as their form, etc., depend on the kind of violence most likely to be borne by

each individual bone in injuries of the cranium; the *squamous suture* is where one bone overlaps the other, as in the squamous suture between the temporal and parietal bones; the surfaces of the bones here also are a little rough; where the edges of the bones are thick the serræ are more regular, and, in general, composed of the whole thickness of the bone, as in the *additamentum suturæ lambdoidalis*, and *squamosæ*, when thin, they are more irregular, longer, more oblique, and composed generally of one or other of the tables; some occasionally spring from the *diplœe*, as may be seen in the junction of the frontal and parietal bones; these sutures are better marked externally than internally, and differ, as already mentioned, in the young and old subjects.

There are several sutures described by anatomists, some named from the bones which form them, some from their shape, nature, etc.: the most remarkable are the *coronal*, *sagittal*, *lambdoidal*, the *squamous*, the *sphenoidal*, and the *ethmoidal*; the *additamentum suturæ lambdoidalis*, *additamentum suturæ squamosæ*.

The *coronal suture*, is situated on the upper part of the skull, and is formed between the frontal and parietal bones; it extends from the anterior extremity of the *sagittal suture*, downwards and forwards on each side, and terminates at the great wing of the sphenoid bone. The *sagittal suture* is situated also on the upper surface of the cranium, directly on the mesial line; it is formed between the two parietal bones, and extends from the centre of the coronal suture, downwards and backwards, to the commencement of the *lambdoidal suture*, it is sometimes continued anteriorly downwards, as far as the nasal bones, and one or two cases have been seen, where it reached

backwards to the foramen magnum—the great longitudinal sinus corresponds to it internally. The *lambdoidal suture* is situated in the posterior part of the skull, and is formed between the occipital and parietal bones ; it extends from the posterior extremity of the sagittal suture downwards and forwards, to the mastoid portion of the temporal bone, where it is crossed internally by the great lateral sinus ; from this it is continued forwards, into the base of the cranium, between the occipital and temporal bones, as far as the foramen lacerum posterius, under the name of the *additamentum suturæ lambdoidalis*, which is also crossed near this foramen, by the same sinus. The *squamous sutures* are situated one on each side of the cranium, and are formed by the squamous part of the temporal overlapping the parietal ; they commence anteriorly at the great wing of the sphenoid bone, pass in a semicircular direction backwards, and terminate at the mastoid part of the temporal bone, from this each is continued backwards to the lambdoidal suture, between the posterior inferior angle of the parietal and the mastoid part of the temporal bone, under the name of the *additamentum suturæ squamosæ*. This is marked internally by the great lateral sinus, and is nearly on a line with the zygomatic arch and a little above the mastoid process. The *sphenoidal suture* is very extensive and irregular, and follows the edge of the sphenoid bone, where it is united to the other bones of the cranium, it has been divided by some anatomists into several sutures according to the bones, with which this articulates, as for instance—the *spheno-parietal*, the *spheno temporal*, etc., it is crossed by the middle artery of the dura mater, in both these divisions. The *ethmoidal suture* is where

the circumference of the cribriform plate of the bone is articulated with the frontal and sphenoid bones. The *additamentum suturæ squamosæ* and the *additamentum suturæ lambdoidalis* have been sufficiently described.

Besides, by these sutures, the bones are connected by the external and internal periosteum or dura mater ; near the course of the sutures, particularly about the sagittal and lambdoidal, may be seen foramina for transmitting veins to the sinuses, which are termed the *emissary veins of Sanctörini*.

THE CRANIUM IN GENERAL.

The *cranium* thus formed, is a large bony cavity, giving lodgement to the brain, its membranes, etc., and may be divided into its *external surface*, and its *internal surface or cavity*; the *external surface* may be subdivided into its *superior, lateral, anterior, posterior and inferior* regions ; of these the *superior region* formed by the parietal and frontal bones, is smooth and convex, marked by the coronal suture anteriorly, and the sagittal suture on the mesial line ; it is covered by the integuments and occipito frontalis muscle, a few small foramina may be seen in it, for the emissary veins of Sanctörini ; it is bounded anteriorly by the frontal eminences, posteriorly by the commencement of the lambdoidal suture ; laterally, by the temporal ridge and parietal eminences. The *lateral region* is formed by the malar, sphenoid, frontal, parietal and temporal bones, it is concave and rough anteriorly, where it forms the temporal fossa, for lodging the temporal muscle ; it is marked by the squamous and other sutures, and by the ramification of blood vessels ;

convex, posteriorly, smooth, and presents the mastoid process and a few small foramina for blood vessels, and the meatus auditorius externus; this region is bounded inferiorly by the zygomatic arch, the meatus auditorius externus, and the mastoid process; anteriorly, superiorly, and posteriorly by the temporal ridge which gives attachment to the temporal aponeurosis; this ridge may be seen to commence at the external angular process of the frontal bone, from this it passes upwards and backwards on the frontal and parietal bones, and terminates posteriorly on the temporal bone where it is continuous with the horizontal root of the zygomatic process. The *anterior region* is formed by the frontal bone, and forms part of the face; it is smooth and irregularly convex; it is covered by the integuments, occipito frontalis, orbicularis palpebrarum, and corrugator supercilii muscles; on the mesial line is a ridge or a suture indicating the junction of the two pieces of which this bone consists at birth, on each side of this is the frontal eminence; beneath this, depressions bounded inferiorly by the eminences formed by the frontal sinuses, and by the superciliary arches and nasal processes; these bound this region inferiorly, laterally it is bounded by the temporal ridge, superiorly it is continuous with the superior region. The *posterior region* is formed by the occipital bone, it is convex covered by the integuments and part of the occipito-frontalis muscle on either side; it is bounded superiorly and laterally by the lambdoidal suture; inferiorly by the occipital protuberance, and the superior semicircular ridge. The *inferior region* or *base* of the cranium exceedingly rough and irregular, presents many eminences, depressions, and foramina;

it may be said to occupy only the two posterior thirds of the skull, as its anterior third is articulated with the bones of the face, and does not appear in the perfect skull; it is formed by the occipital, temporal, and sphenoid bones, on it may be seen, as we pass from behind forwards; the occipital protuberance, and on each side of this the superior semicircular ridge; a rough surface, into which are implanted the splenius and complexus muscles; the inferior semicircular ridge, then another rough surface between it and the foramen magnum, into which are inserted the posterior recti, and the superior oblique muscles; a longitudinal ridge, running from the occipital protuberance to the foramen magnum, separates this portion of the bone into two lateral surfaces, and gives attachment to the ligamentum nuchæ; in front of this is the foramen magnum, bounded anteriorly and laterally by the condyles; in front of these is the anterior condyloid fossa and foramen, behind it the posterior condyloid fossa and foramen; external to the condyles are rough surfaces for the insertion of the lateral recti muscles, the jugular process, occasionally a groove for the occipital artery, the additamentum suture lambdoidalis, the digastric depression, and the mastoid process; in front of the foramen magnum is the cuneiform or basilar process, giving attachment to the anterior recti muscles posteriorly, the superior and middle constrictors of the pharynx in the middle, and forming the roof of the pharynx anteriorly, where it terminates by forming the sphenoid bone, and forming the speno-occipital suture, in front of it lies the body of the sphenoid bone, forming the roof of the nose; on each side of the cuneiform process are, from

behind forwards, the foramen lacerum posterius, formed between the petrous portion of the temporal bone, and the occipital; the commencement of the carotid canal; still more anteriorly, and a little internally is a rough surface, a part of the petrous portion of the temporal bone, from which arise the levator palati and laxator tympani muscles; the foramen lacerum anterius, formed by the sphenoid and temporal bones; immediately in front of the carotid foramen is the spinous process of the sphenoid, then the spinous foramen, still more anteriorly, the foramen ovale, and then the roots of the pterygoid processes, the fossa navicularis, the commencement of the pterygoid fossa; external to all these are, the stylo-mastoid foramen, the styloid process, encased in the vaginal process, the glenoid cavity divided by the glasserian fissure, the transverse root of the zygoma, the zygomatic fossa, and the speno-maxillary fissure; the inferior region is bounded posteriorly by the occipital protuberance, and superior semicircular ridge, anteriorly by the body of the sphenoid bone; the roots of the pterygoid processes, and the speno-maxillary fissure; laterally by the mastoid process, the meatus auditorius externus, and the zygomatic arch.

It will be sufficient to divide the *internal surface* of the cranium into a *vault*, or *roof*, and a *floor*, or *base*. The *vault*, or *roof*, is concave, larger posteriorly than anteriorly, and is formed by the frontal, parietal, and occipital bones, the great wing of the sphenoid, and the squamous portion of the temporal bones. In it may be seen, on the mesial line, the crest of the frontal bone, the groove for the longitudinal sinus extending from the crest upwards

and backwards along the frontal bone, between the two parietals, and then marking the occipital bone posteriorly, and terminating at the internal occipital protuberance; the sagittal suture not so well marked here as externally; on each side of the mesial line depressions, corresponding to the glandulæ Pacchioni, and foramina for the transmission of vessels; still more laterally may be observed irregularities of the bone, produced by the convolutions of the brain. (Bichat has stated that the convexities of the convolutions of the brain correspond frequently to the convexities on the bone, and that the depressions also frequently correspond to one another. We cannot conceive, however, that this can be the case, as a vacuum must then exist between portions of the brain and the bone). Here may be seen, also, the course of the branches of the middle and other arteries of the dura mater; in front and on each side of the frontal crest the bone is a good deal excavated, to lodge the anterior lobes of the brain; in it may be also seen the coronal suture.

The *Floor* or *base* of the internal surface of the cranium is still more irregular than that of the external surface; it is also more extensive as it reaches from the frontal to the occipital bone, it may be seen to be divided into three *fossæ* on each side, one above the other, termed the *anterior*, *middle*, and *posterior fossæ*; these are all lined by dura mater and support the brain; the *anterior fossæ*, one on each side, are formed by the cribriform plate of the ethmoid, the orbital plates of the frontal and the lesser wings and olivary process of the sphenoid bone; in the centre is the crista galli; in front of this is the *foramen cæcum*, formed between the frontal and ethmoid

bones; on each side of it the olfactory grooves perforated by the foramina for the olfactory nerves and the slit-like apertures for the nasal nerves, then the junction between the ethmoid and frontal bones, where may be seen the terminations of the anterior and posterior internal orbital foramina, and bounded behind by the suture which joins the ethmoid and sphenoid bones; laterally this surface is rough and convex, slopes upwards and outwards, and supports the anterior lobes of the brain; each fossa is bounded posteriorly by the lesser wing of the sphenoid, to which is attached the sphenoidal fold of the dura mater, and which terminates internally at the anterior clinoid process which gives attachment to the inner concave margin of the tentorium cerebelli, and beneath which is the *optic foramen*, through which pass out the optic nerve and the ophthalmic artery; between the optic foramina is the olivary process, on which rests the commissure of the optic nerves; the *middle fossæ* of the cranium larger than the anterior, are formed by the sphenoid and temporal bones, and are separated by the sella turcica, in the centre may be seen the sella turcica for lodging the pituitary gland, bounded in front by the anterior clinoid and olivary processes, behind by the posterior clinoid processes, and laterally marked by grooves for the carotid artery and the cavernous sinus; on the outer side of this the middle fossæ are much excavated, and give lodgement to the middle lobes of the brain; in each may be seen anteriorly, the *foramen lacerum orbitale*, formed between the frontal and sphenoid bones, and giving transmission to the third, fourth, first division of the fifth and the sixth nerves; the ophthalmic vein, and the second head of the

external rectus muscle; behind this, and near its inner extremity, is the *foramen rotundum*, for the passage of the superior maxillary nerve or second division of the fifth, it commences posteriorly in a groove, posterior and external to this, is the *foramen ovale* for the passage of the third division of the fifth or inferior maxillary nerve; behind this and to its inner side is the *foramen lacerum anterius*, which is crossed by the carotid artery and the vidian nerve, and transmits branches of arteries to supply the dura mater; to its outer side is the *spinous foramen* for the passage of the middle artery of the dura mater; behind these is the upper surface of the petrous portion of the temporal bone, containing the *hiatus Fallopii*, through which passes the vidian nerve, and marked by the convolutions of the brain, and the superior semicircular canal; laterally where each fossa is formed by the great wing of the sphenoid and the squamous portion of the temporal bone, it is marked by the branches of the middle artery of the dura mater; this artery enters the spinous foramen, crosses the squamous portion of the temporal bone, then the anterior inferior angle of the parietal, then branches out on the parietal, frontal, and temporal bones: these fossæ are separated from the posterior by the edge of the petrous portion of the temporal bone; this is grooved by the superior petrosal sinus, except internally, where it is smooth, concave, and crossed by the fifth nerve; it gives attachment to the convex margin of the tentorium cerebelli which is finally implanted into the posterior clinoid process. The *posterior fossæ* are the largest of the three; they are separated by the cuneiform process of the occipital bone in front, the foramen magnum in the centre, and the vertical

part of the crucial ridge posteriorly; they are subdivided into two inferior, and two superior by the tentorium cerebelli; the inferior give lodgement to the lateral lobes of the cerebellum; the superior, smaller, lodge the posterior lobes of the brain, which rest on the tentorium cerebelli attached to the transverse part of the crucial ridge; on the mesial line we observe the basilar gutter formed by the sphenoid and occipital bones, it is concave, supports the pons Varolii, and is crossed by the transverse occipital sinuses, it is bounded laterally by the grooves between the basilar process and the petrous part of the temporal bone, in which are lodged the inferior petrosal sinuses; at its superior part is a small notch for the sixth nerve, behind the basilar gutter is the *foramen magnum*, larger and more rounded off internally than externally; to its circumference is attached the dura mater, anteriorly it gives attachment to the apparatus ligamentosus colli, and on either side of this to the check ligaments. In it may be seen the openings of the *anterior condyloid foramina*, throughout which pass the lingual or ninth nerves. Through the foramen magnum pass the medulla oblongata, the vertebral arteries, the spinal accessory nerves, and the membranes of the spinal marrow. Behind it is the vertical portion of the crucial ridge, bifurcated inferiorly, presenting the internal occipital protuberance in its centre, and gradually lost superiorly. Its inferior part gives attachment to the falx cerebelli, containing the posterior occipital sinuses, its superior to the falx cerebri, in which is contained the great longitudinal sinus; the torcular Hierophyli corresponds to the occipital protuberance, or to one side of it, most frequently the right; on each side of the mesial line we observe the posterior surface of

the petrous portion of the temporal bone, presenting the *meatus auditorius internus*, which transmits the portio dura and mollis; the *opening of the aqueduct of the vestibule*, and an irregular aperture, to which the dura mater is attached; beneath this the *foramen lacerum posterius*, formed between the occipital and petrous part of the temporal bone; this is elongated forwards and inwards, divided by a bony or cartilaginous partition, into an anterior and posterior part, the anterior, which is also internal and smaller, transmits the eighth pair of nerves; the posterior, which is external and larger, the jugular vein; this opening is frequently larger in one side than the other, particularly on the right side; leading into it is a deep gutter, which points out the course of the lateral sinus; this commences at the internal occipital protuberance, passes forwards and outwards, grooves the occipital bone, then passing directly forwards, grooves the posterior inferior angle of the parietal; then descends forwards and inwards, and grooves the mastoid portion of the temporal bone, in which part of its course the mastoid foramen generally terminates; and finally curving forwards, grooves the occipital bone a second time; in the anterior edge of the foramen lacerum, may be seen the *opening of the aqueduct of the cochlea*. At the posterior part is the crucial ridge of the occipital bone, the vertical portion being on the mesial line, as just described; the transverse part marked by the lateral sinus, deeper in general on the right than the left side, gives attachment to the tentorium cerebelli. In this part of the internal surface of the cranium, may be seen the course of the lambdoidal suture, and the additamentum suturæ lambdoidalis, not so distinct as externally.

The *cranium* is remarkably contrasted with the other cavities of the body ; in the immobility of its parieties, and its excluding all pressure from the contained organs : the *thorax*, on the contrary, is formed so as to enjoy considerable motion, in order that its cavity may be increased, and the lungs distended with air, but at the same time that undue pressure may be excluded from them. The *abdomen* is remarkably contrasted with both these, in not only allowing considerable motion of its contained organs, but also permitting that pressure on them, so necessary for the due performance of their functions, and the *pelvis* we find constructed so as to be immoveable itself, but, at the same time to allow of the pressure exerted by the abdominal muscles, to act on the organs contained in its cavity ; here then, the *first* of these cavities prevents *pressure* on, and *motion* of its contained organs, with the exception of the motion produced in the brain by the arterial circulation, and by respiration ; the *second* enjoys motion in itself, permits the *motion* of its contained organs, exercises a certain degree of *pressure* on them necessary for the purposes of respiration, but excludes all undue pressure ; the *third* admits of both *motions* of its contents, and exercises considerable *pressure* on them ; the *fourth* admits of *pressure* on, and *motion* of, its contained organs, but possesses no *motion* itself. On reviewing the mechanism of each of these cavities, it will be found that each is formed precisely with reference to the functions performed by the organs which it contains.

SECTION II.

THE FACE.

The *face* is situated at the inferior and anterior part of the skull, and is much more irregular than the cranium; it contains the cavities of the orbits, the nose, and the mouth; it is wide superiorly, more narrow inferiorly, and is formed by fourteen bones, *two superior maxillary, two malar, two palate, two nasal, two inferior spongy, two ossa unguis, one vomer, and one inferior maxillary bone*; besides these, the maxillary bones contain the teeth, which are thirty-two in number.

The *superior maxillary bones*, are the second largest of the face, and articulate with all the rest except the inferior maxillary; they are placed, one on each side, in the centre of the face, between the orbits superiorly, the mouth inferiorly, the malar bones externally, the nasal cavity internally, and the palate bones posteriorly; anteriorly they are free in the greater part of their extent, they are irregular in shape, and present four *surfaces* for examination; an *external, internal superior and inferior, and a circumference*. The *external surface*, arched from before backwards, is directed forwards and outwards anteriorly, backwards posteriorly; from its anterior and upper part arises a remarkable projecting process of bone, termed the *ascending or nasal process*; this is triangular in shape; its apex turned upwards, is rough, and articulates with the nasal process of the frontal bone; its base, turned downwards, is continuous with the body of the bone, its external surface is smooth, concave from above downwards, is marked by foramina for the transmission of vessels,

and affords attachment to the levator labii superioris alæque nasi muscle inferiorly, the tendo oculi superiorly; its *internal surface* is rough, convex from above downwards, and forms part of the outer wall of the nasal fossa; superiorly it is irregular, and joins with the lateral masses of the ethmoid bone; below this is a gutter which forms part of the middle meatus narium, bounded inferiorly by a horizontal ridge, to which is connected the inferior spongy bone; anteriorly it is thin, and most frequently grooved for interlocking with the nasal bones; posteriorly is a deep groove, larger superiorly and inferiorly, than in the centre, which forms with the os unguis and the inferior spongy bone, the nasal duct; the outer edge of this groove gives attachment to a few fibres of the orbicularis palpebrarum muscle; its internal edge longer and more projecting, articulates with the os unguis; beneath and external to the nasal process this surface of the bone expands and presents a tolerably deep concavity, termed the *canine fossa*; in the upper part of this may be seen the *infra-orbital foramen*, which gives transmission to the artery and nerve of the same name; above this foramen, which is sometimes double, the bone gives attachment to the levator labii superioris alæque nasi muscle, beneath it to the levator anguli oris muscle; internally this fossa is bounded, superiorly, by a free edge, thin and concave, to which is attached the ala nasi, inferiorly by a superficial depression, termed the *myrtiform depression*; inferiorly it is irregular, and presents the projections of the alveolar processes; as we pass backwards towards the posterior part of this surface, we meet with a rough triangular process, the *malar process*, which articulates with the malar bone; this

is gradually lost inferiorly ; beneath it arises the buccinator muscle ; behind this the bone is convex, projects considerably backwards, and forms the *tuberosity*. This is better marked in the young subject, from its containing one of the *dentes sapientiæ*, it gives attachment to the external pterygoid muscle ; it is rough posteriorly, and articulates with the palate bone ; it is marked by the *posterior dental canals*, giving transmission to the nerves of the same name. The *internal*, or *nasal surface*, forms part of the outer wall of the nasal fossæ ; it is irregularly concave ; anteriorly it presents the internal surface of the nasal process already described ; beneath the horizontal ridge on this is a smooth concave surface, which forms part of the inferior meatus ; behind this is the groove for the nasal duct ; still more posteriorly, a large irregular opening, which leads into the *antrum Highmorianum*, or *superior maxillary sinus*. This sinus, the largest of the sinuses of the head, is of a triangular shape ; its apex externally at the malar process, its base internally towards the nose ; it is bounded superiorly by the orbital plates, and infra orbital canal ; inferiorly by the alveolar processes only, as it does not extend into the palate process ; anteriorly by the canine fossa and anterior dental canals ; posteriorly by the tuberosity and posterior dental canals. The internal surface of the sinus presents traces of vessels and nerves, and is lined by the pituitary membrane ; it is frequently perforated by the fangs of the molar teeth, and is encroached on in the young subject towards its posterior part by the *dens sapientiæ* ; its opening in the articulated skull is much smaller than in the separated bone, being partially closed superiorly by the eth-

moid bone ; posteriorly, to a considerable extent, by the vertical plate of the palate bone ; inferiorly and anteriorly by the inferior spongy bone ; it opens into the middle meatus narium, and is liable to many diseases, as will be hereafter mentioned. Inferiorly the opening of the sinus presents the overlapping of two plates of bone the internal of which articulates with the palate bone ; the external passes into the sinus ; at the upper part of it may be seen irregularities, and, in some cases, small cells, which are connected with the ethmoidal cells ; behind it is a rough surface, long and convex, from above downwards, which articulates with the vertical plate of the palate bone ; it is here marked by a superficial groove directed forwards and outwards, which assists in forming the *posterior palatine canal*. From the inferior part of this surface of the bone projects the *palate process* of the superior maxillary bone ; this slopes downwards and backwards, is concave from side to side, and forms, by its superior surface, part of the floor of the nose ; it is somewhat quadrilateral ; its anterior edge, short and concave, forms part of the boundary of the anterior nares ; its posterior, rough, articulates with the palate process of the palate bone which rests on it ; its external edge is attached to the rest of the bone ; its internal, the most extensive, is rough, of considerable extent, particularly anteriorly, and articulates with its fellow of the opposite side, forming with it a narrow groove, into which is received the inferior edge of the vomer ; near its anterior extremity may be seen a groove which occupies only the inferior half of the bone, and which forms, with its fellow of the opposite side, the *foramen incisivum*, in which is lodged Cloquet's ganglion.

This groove leads superiorly into the anterior palatine canal, which forms a distinct foramen above, and transmits the nerve of Cotunnus; anteriorly this edge of the bone terminates in a spine, which forms, with the opposite bone, the *anterior nasal spine*. The *superior, or orbital surface* forms part of the floor of the orbit; it is smooth and triangular, and slopes downwards, forwards, and outwards; nearly in its centre, and running from behind [forward, is a deep groove, forming the commencement of the *infra orbital canal*, which gives transmission to the artery and nerve of the same name. This canal, at first only a groove, is formed between the floor of the orbit and the roof of the antrum; it proceeds downwards and forwards, and terminates anteriorly by dividing into two canals; the posterior of these, the smaller, descends into the anterior wall of the antrum, and conveys a small branch of the infra orbital nerve and artery; the anterior, larger, follows the original direction of the canal, and terminates at the infra orbital foramen. This surface is bounded internally by a sharp edge which articulates with the os unguis anteriorly, the os planum posteriorly; externally by the malar process; behind this it presents a smooth rounded edge, which forms part of the *spheno-maxillary fissure*; this is a large cleft or fissure directed downwards, forwards, and outwards; and situated between the inferior and outer wall of the orbit; although termed spheno-maxillary, the palate bone assists in forming it internally where it is continuous with the foramen lacerum orbitale, and the malar completes it anteriorly; it is crossed by the superior maxillary nerve, the orbital branch of which passes through it into the orbit, the internal maxillary

artery terminates in it; the foramen rotundum opens into it posteriorly, and near its internal extremity; the infra orbital canal commences at its anterior edge, and nearly in its centre, so that the superior maxillary, or infra orbital nerve, crosses the fissure obliquely forwards and outwards, to reach the infra orbital canal. A little beneath its internal extremity may be seen the sphenopalatine foramen; anteriorly the orbital surface of the superior maxillary bone is bounded by an edge of small extent, which forms part of the circumference of the orbit, immediately behind which arises the inferior oblique muscle of the eye; its apex, turned backwards, is rough, and articulates with the palate bone. *The inferior, or palate surface*, is formed by the under surface of the *palate process*: this is exceedingly rough and irregular, much more so than its superior surface, or than the corresponding surface of the palate bone, and gives attachment to the fibro-mucous membrane, lining the roof of the mouth; posteriorly it is grooved close to the alveolar process for the passage of the posterior palatine nerves and vessels; anteriorly is the groove for the formation of the foramen incisivum; it terminates externally and anteriorly in the alveolar processes.

The *circumference* of the superior maxillary bone is exceedingly irregular, commencing at the summit of the nasal process; it here articulates with the nasal process of the frontal bone; descending from this anteriorly, it is grooved for articulation with the nasal bone; beneath this it is sharp, thin, and curved, forms part of the anterior nares, and has attached to it the alæ nasi; passing inwards is the prominence which forms, with its fellow, the anterior

nasal spine ; behind, and inferior to this, is the rough surface, deep anteriorly, more shallow posteriorly, by which it articulates with the opposite maxillary bone, and with which it forms the groove for the vomer ; in the anterior extremity of this is the depression for the formation of the foramen incisivum ; behind this surface is the posterior edge of the palate process, bevelled off on its superior surface to support the palate process of the palate bone ; behind this is a rough surface, which also articulates with the palate bone ; ascending from this is the rough elongated surface for articulation with the vertical plate of this bone, and presenting the groove for the formation of the posterior palatine canal ; this is surmounted by the apex of the orbital process, which articulates with the orbital process of the palate bone ; passing forwards from this it is thin and articulates with the os planum behind, the os unguis in front ; from this we cross the groove for the nasal duct to its internal edge, which also joins the os unguis ; we here meet the summit of the nasal process, descending from this outwards is the external edge of the nasal duct, then the smooth edge which forms part of the circumference of the orbit ; external to this is the rough surface which articulates with the malar bone, behind which is a smooth edge forming part of the speno-maxillary fissure presenting the commencement of the infra orbital canal ; inferiorly the circumference of the superior maxillary bone presents the superior row of *alveolar processes*, this is thicker behind than before, is curved and perforated by the *alveoli*, eight in each bone, in which are lodged the superior row of teeth ; they vary in different subjects, according to the teeth which they contain, and

according to the age of the individual; the first is most internal, contains the first incisor tooth, and is deeper than the second which contains the second incisor, the third is much deeper and contains the canine tooth, it is somewhat conical, long from before backwards and projects much on the outer surface of the bone, these three are single depressions, the fourth and fifth are not so deep, are double and contain the bicuspid teeth; the sixth, seventh, and eight are not so deep and contain the three molar teeth, of these the sixth and seventh present three depressions; most frequently two on the outer edge, and one on the inner; the eighth is irregular and may contain either one, two, or three depressions, it lodges the dens sapientiæ; the fangs of these teeth sometimes perforate the cavity of the antrum, and occasionally appear externally through the bone; the *external border* of the alveoli is more dense and compact than the *internal* which is, however, thicker than it; this is more spongy and perforated by vessels passing to the parieties of the alveoli.

The *structure* of the superior maxillary bone is much the same as the flat bones of the cranium; in many situations, however, it is wholly compact, in others, chiefly spongy; it *articulates* with two bones of the cranium, the ethmoid and frontal, and occasionally with the sphenoid; it articulates with all the other bones of the face, except the inferior maxillary; its processes are the nasal or ascending, the anterior nasal spine, the palate process, the orbital process, or plate, the malar process, the alveolar process, and the tuberosity; its proper foramina are the infra-orbital, the anterior-palatine foramen or canal, and the opening into the antrum; it has but one common,

the foramen incisivum, besides these, it assists in forming the speno-maxillary fissure, the nasal duct, and the posterior palatine canal, and contains the infra orbital canal, the anterior and posterior dental canals. It is developed from several points of ossification, one of which seems to be analagous to the inter-maxillary bone of quadrupeds. To place it in situ, its nasal process must be directed upwards and backwards, the infra orbital foramen forwards, the alveoli, downwards, its palate process so as to slope downwards and backwards, and its malar process outwards and slightly forwards.

The *Palate bones* are two in number, placed one on each side, between the pterygoid plates of the sphenoid behind, and the superior maxillary bone in front, with which they were for a long time confounded by anatomists,—extending superiorly into the orbits, inferiorly into the palate, internally forming part of the outer wall of the nose, externally hardly seen in the cleft between the pterygoid processes, and the tuberosity of the superior maxilla; each of them consists of *two plates*, of which one is *horizontal*, the other *vertical*, from this circumstance they resemble the letter L much in shape; the *horizontal plate* of the palate bone called also its *palate process*, projects horizontally inwards from the lower extremity of the vertical plate, and appears in the articulated bones as a part of the corresponding process of the superior maxilla; it is quadrilateral, its superior surface is smooth and concave from side to side, and forms the most posterior part of the floor of the nares; its inferior rough, but much less so than that of the palate process of the superior maxilla, is slightly excavated, forms part of the roof of the mouth, and

is covered by mucous membrane ; at its posterior and outer part may be seen an oval foramen, sometimes double, the termination of the *posterior palatine canal*, and behind this a transverse crest into which the circumflexus palati muscle is implanted ; its anterior edge is cut off obliquely on its under surface and rests on the palate process of the superior maxilla ; its posterior is free, and arched and gives attachment to the velum pendulum palati ; it terminates internally in a projection which unites with that of the opposite bone to form the *posterior nasal spine*, from which arises the azygos uvulæ muscle ; its internal edge is rough and broad, and articulates with the opposite bone, completing posteriorly the drain or groove which receives the vomer ; externally it joins the vertical plate. The *vertical* or *ascending plate* of the palate bone passes from the horizontal plate upwards and inwards, converging towards its fellow superiorly ; it is broad and thin inferiorly, contracted in the centre, rough and irregular superiorly where it terminates in two processes ; an *anterior* or *orbital*, a *posterior* or *sphenoidal* separated by a foramen, the *spheno-palatine foramen* ; its internal or nasal surface is irregular, and forms part of the outer wall of the nose ; it is divided by a horizontal ridge into a superior and inferior part ; the superior forms part of the middle meatus ; the inferior part of the inferior meatus ; to the ridge is connected the inferior spongy bone ; its external surface is irregular and applied in almost its whole extent to the inner surface of the superior maxillary bone, it is grooved posteriorly for the formation of the *posterior palatine canal* ; the groove terminates inferiorly in the posterior palatine foramen ; above this a small portion is free and

appears in the bottom of the zygomatic fossa; the anterior edge of this plate is thin and sharp, and closes up the antrum Highmorianum posteriorly, its posterior edge is irregular and joins the pterygoid process of the sphenoid bone, inferiorly it terminates in a conical projection turned backwards and outwards, the *tuberosity* of the palate bone, which is received into the triangular interval which separates the two pterygoid processes anteriorly; it is marked by three grooves of which the internal is the deepest and receives the internal pterygoid plate, the external receives the external pterygoid plate; the middle forms part of the pterygoid fossa; this process is perforated by one or two foramina which lead from the posterior palatine canal; at the upper extremity of the horizontal plate may be seen the *orbital* and *sphenoidal processes*, the *orbital process* is the anterior and larger of the two, it is supported by a contracted portion of the bone, on the inner side of which is a ridge which articulates with the middle spongy bone, and above this a groove which forms part of the superior meatus; it presents five surfaces for examination, an *external* smooth, forming part of the zygomatic fossa, and separated from the superior by a smooth edge which forms part of the spheno-maxillary fissure, an *internal* rough, which joins the ethmoid bone, an *anterior* rough, and directed downwards and outwards, articulates with the superior maxillary bone; a *posterior* directed upwards and inwards, frequently hollowed out into a cell which joins the sphenoidal sinus; a *superior* smooth which forms the most posterior part of the floor of the orbit; the *sphenoidal process* is the posterior; it is smaller and thinner than the other, internally it forms part of the

nasal fossa, externally part of the zygomatic fossa; above it joins the body and cornu of the sphenoid bone, and presents a groove for the formation of the *pterygo palatine canal*, these two processes are separated by a deep notch which is completed into a foramen, the *spheno-palatine foramen*, by the sphenoidal cornu above, and corresponds to the spheno-palatine or Meckel's ganglion, it is sometimes complete in the palate bone; it transmits arteries and nerves of the same name into the nasal fossæ. The *circumference* of the palate bone need not be repeated, it articulates with the sphenoid, ethmoid, opposite palate, the sphenoidal cornu, the superior maxillary, the inferior spongy bone and the vomer; its *structure* is chiefly compact, it contains spongy tissue in its tuberosity, orbital and palate processes; its processes are the palate, the tuberosity or pterygoid process, the orbital, the sphenoidal and posterior nasal, its proper foramen is the posterior palatine, its common, the spheno-palatine, besides these foramina it assists in forming the posterior palatine and pterygo palatine canals, and the spheno-maxillary fissure; it appears to be developed by one point of ossification which commences at the junction of its horizontal and vertical portion and its tuberosity.

The *Vomer* is a single bone, placed generally on the mesial line, but sometimes inclining to one side, and forming part of the septum narium; it is thin, flat, and quadrilateral, and resembles in shape a plough share,—hence its name. It possesses four *edges*, and two *surfaces*; its *anterior superior* edge slopes downwards and forwards, and presents a channel which receives the nasal lamella of the ethmoid posteriorly, the triangular cartilage of the

nose anteriorly ; it is here occasionally not grooved, and then the cartilage presents a channel for its reception. Its *inferior* or *palatine edge* is the longest ; it is thin posteriorly, a little thicker, and sometimes grooved anteriorly, and is received into the channel formed by the apposition of the palate processes of the superior maxillary and palate bones ; its *posterior superior* edge is bifurcated to receive the azygos process of the sphenoid bone, and expands laterally into two plates of bone which are received into the drains on the nasal surface of the body of the bone ; its *posterior* or *guttural edge* is the shortest, it is broader superiorly than inferiorly, a little arched, is free, and forms the septum between the posterior nares ; the surfaces are tolerably smooth, and lined by the pituitary membrane ; they are marked by the passage of vessels, and the nerves of Cotunnus. The vomer articulates with the sphenoid, the sphenoidal cornua, the ethmoid, palate and superior maxillary bones, and the triangular cartilage ; its *structure* is compact, except at its posterior superior edge.

The *inferior spongy*, or *turbinated bones* are two in number, placed one on each side in the outer wall of the nose, between the middle and inferior meatus ; each is curved from within outwards, like the spongy bones of the ethmoid, but, unlike these, it is in general a distinct bone, connected to the superior maxillary and palate bones. Its internal surface is convex, rough, and irregular, and covered by the mucous, or pituitary membrane ; its internal, also covered by mucous [membrane, is concave, smooth, and forms part of the inferior meatus ; its inferior edge, free, is twisted outwards, thin at either extremity,

thick and spongy in the centre ; its superior edge is exceedingly irregular, anteriorly it slopes downwards and forwards, is cut off on its outer edge, and joins the ridge on the ascending or nasal process of the superior maxillary bone, behind this a delicate process ascends from it forwards, which joins the descending process of the os unguis, to close the nasal duct on its inner side ; posterior to this it sends up a delicate process, which connects it to the ethmoid, and presents a hook-like process, by which it articulates with the edge of the antrum, the opening of which it closes up inferiorly ; immediately behind this it is grooved to articulate with the ridge on the vertical plate of the palate bone ; anteriorly and posteriorly it terminates by two angles, of these the posterior is the longer and more acute, and supports a prolongation of the mucous membrane. Its *structure* is chiefly spongy, it is developed by one point of ossification, it articulates with the superior maxillary, palate and ethmoid bones, and the os unguis.

The *os unguis* or *lachrymal bone* is placed one on each side in the inner wall of the orbit at its anterior part between the frontal bone above, the superior maxillary below and in front, and the os planum of the ethmoid behind ; it is exceedingly thin and delicate, and is the smallest bone of the face ; its *external* or *orbital surface* somewhat convex, is divided by a vertical projecting ridge, terminating inferiorly in a hook-like process, into an *anterior* and *posterior* part ; the *anterior* part excavated, is long from above downwards, perforated by small pores, and forms part of the lachrymal gutter for giving lodgement to the lachrymal sac ; the *posterior* nearly plane, is longer from before backwards, but shorter in the

vertical direction, and forms part of the inner wall of the orbit; it gives origin to the tensor tarsi or Horner's muscle; the *internal* or *nasal* surface concave, is divided in a like manner, by a vertical groove, corresponding to the ridge on the outer surface; its *anterior* portion forms part of the middle meatus; the *posterior* assists in closing up the anterior ethmoidal cells; its *superior* edge short and irregular, articulates with the internal orbital process of the frontal bone; the *inferior* articulates posteriorly with the orbital plate of the superior maxillary bone; from its anterior part descends a thin, delicate process which unites with the ascending process of the inferior spongy bone to complete the nasal duct internally; the *posterior* edge articulates with the os planum of the ethmoid; the *anterior*, with the internal edge of the lachrymal groove of the superior maxillary bone; its *structure* is compact; it is developed by one point of ossification; its articulations are sufficiently described.

The *Nasal bones* are two in number, and are placed in the anterior part of the face, filling up the interval which exists between the nasal processes of the superior maxillary bones; they are elongated, and concave from above downwards, narrow and convex in the transverse direction; the *anterior surface* smooth, is perforated in its centre by a foramen which transmits a vein into the pituitary membrane, and gives exit to a branch of the nasal nerve; the *posterior surface*, rough and concave, is marked by a vertical groove which indicates the course of one of the nasal nerves; the *external* edge, longer than the internal, interlocks with the nasal process of the superior maxillary bone; its *internal* edge, thick above, thin

below, rests against the opposite bone ; they together form a groove posteriorly which receives the nasal spine of the frontal above, the edge of the nasal lamella of the ethmoid below ; the *superior extremity* is rough, thick, and irregular, and joins the nasal process of the frontal bone ; its inferior elongated, and thin, descends farther externally than internally, and joins the lateral cartilages of the nose ; it is notched in the centre for the passage of the naso-lobular nerve ; the nasal bones are so firmly articulated that they are seldom dislocated without fracture ; their *structure* is chiefly spongy ; they are developed from one point of ossification ; their articulations are sufficiently indicated.

The *Malar bones* are placed, one on each side, in the anterior and outer part of the face between the frontal above, the superior maxillary beneath, and the temporal behind ; they assist in forming the orbital and temporal fossæ : each is somewhat quadrilateral in shape ; its *external surface* is convex and smooth, is perforated by one, two, or sometimes more foramina which give transmission to nerves and vessels ; it is covered in a great part of its extent by the orbicularis palpebrarum muscle, and gives origin to the zygomatic muscles ; its *posterior* surface, concave, is smooth posteriorly, and forms part of the temporal fossa ; rough and irregular anteriorly where it articulates with the malar process of the superior maxillary bone ; its *superior* or *orbital* surface is the smallest ; it is concave, and forms part of the floor and outer wall of the orbit, in it may be observed, one or two foramina leading to the outer surface of the bone ; its superior edge is free, rounded, and concave, and forms part of the circumference of the orbit ; its *inferior* also free, is nearly straight, and

gives origin to the masseter muscle; the *internal* slopes downwards and outwards, is rough, and joins the superior maxillary bone; the *posterior* thin, is irregular, and gives attachment to the temporal aponeurosis; the posterior edge of its orbital plate joins the orbital plate of the sphenoid above; the superior maxillary bone inferiorly; between these it is smooth, and bounds the speno-maxillary fissure in front; four angles are formed by the junction of these edges, the two *anterior* unite with the superior maxillary bone; of the *posterior*, which are the best marked, the superior ascends nearly vertically upwards, and supports the external orbital process of the frontal bone; the inferior passes backwards and outwards, and terminates by a rough serrated edge, better marked internally than externally, directed first downwards, then downwards and backwards, and joins the zygomatic process of the temporal bone, forming with it the zygomatic arch.

Although we have not as yet described the inferior maxillary bone, we may here consider the face in general. The *face* is much smaller than the cranium, forming only about one-third of the head; it is broad and expanded above, but becomes more narrow towards its inferior part; its vertical extent is greater than its transverse; it presents a much more irregular surface than the cranium, and like this is subject to many varieties, depending on age, sex, country, etc.; it presents a remarkable contrast with the cranium, in being formed by a greater number of bones, and containing several cavities instead of *one*; these are the two *orbits*, the *nasal fossæ*, the *cavity of the mouth*, and that of the *antrum* on each side; its bones are united by different species of

suture which it is unnecessary to describe *seriatim*; some are serrated, but many are not: thus, the articulations of the vomer are instances of *Schindylesis*; those of the two superior maxillary, and of the two nasal bones, where they are in contact with each other, belong to the class *Harmonia*; in order that they may more perfectly support one another when violence is offered to the head, the tendency being, under such circumstances, to force these bones together, they are here, therefore, joined by *broad surfaces*. The face is much smaller, and the processes less marked in the female than the male; in the young subject it is very imperfectly developed.

The *inferior maxillary bone* is the symmetrical bone, which is placed at the lower and anterior part of the face, and is much the largest of all its bones; it is curved on itself so as to resemble a horse shoe in shape, and is divided into a *body*, *angles* and *rami*; being symmetrical, the description of one half will apply equally to the other; the *body* of the lower jaw is that which occupies its anterior inferior part, extending almost horizontally, but with a slight degree of obliquity upwards towards the *rami* which it joins so as to form the angles; its *external* or *cutaneous* surface is irregularly convex; on it we perceive on the mesial line a vertical ridge, the *symphysis*, which indicates the junction of the two pieces of which this bone is composed in early life, it terminates inferiorly in a projection, more or less marked termed the mental process, above and to the outer side of this is a superficial depression from which arises the levator labii inferioris muscle; from the inferior part of the mental process passes upwards and outwards to the anterior edge of the coronoid process;

the *external oblique ridge*, a projecting ridge which gives origin to the depressor labii inferioris internally, to the depressor anguli oris, and a few fibres of the platysma myoides externally, above this ridge and nearly in the centre of the body, but somewhat nearer the symphysis and immediately beneath the second bicuspid tooth, is the *mental foramen*, a round foramen which terminates the inferior dental canal and transmits the mental nerve, the external branch of the inferior dental, accompanied by a small artery ; above and behind this the bone presents a groove which terminates at the inner side of the coronoid process, and which gives attachment in its posterior half to the buccinator muscle ; the remainder of this surface is lined by the mucous membrane of the mouth ; its *internal* surface is concave, and is covered to a great extent by the mucous membrane ; on the mesial line we perceive the internal aspect of the symphysis giving attachment to the frænum linguæ ; below this are four eminences, the *genial processes*, two *superior* and two *inferior* ; the two superior give origin to the genio-hyo-glossi muscles, the two inferior to the genio-hyoid ; occasionally these eminences are indistinct, and their places supplied by a ridge ; below these, and a little to their outer side is a superficial depression for the insertion of the anterior belly of the digastric muscle ; above the genial processes, and also external to them is the depression for the sublingual gland ; between these depressions, and on a level with the genial processes is the commencement of the *internal oblique*, or *mylo-hyoidean line* ; this line, more projecting than the external, passes upwards, backwards, and outwards, becoming much more distinct as it ascends

and terminates at the inner surface of the coronoid process ; it gives origin to the mylo-hyoid muscle in its anterior two thirds ; in the posterior third, to the superior constrictor of the pharynx, beneath this line and about its centre is a depression in which is lodged the sub-maxillary gland : the *inferior edge* or *base* of the lower jaw is round, obtuse, particularly anteriorly, and slopes a little upwards and backwards ; it is subcutaneous, except near to the angle, where it is crossed by the labial artery, and gives attachment to a few fibres of the platysma-myoides muscle ; its *superior edge* is irregular, and marked by the alveoli ; it is somewhat compressed and vertical anteriorly, thicker and turned inwards posteriorly ; in it may be seen the *depressions* for the teeth of the lower jaw ; these are sixteen in number, eight on each side, and vary as in the upper jaw, according to the teeth which they contain ; the *first two*, which contain the incisor teeth, are long from before backwards, and are the smallest ; the third contains the canine tooth or cuspidatus, and is the deepest ; the fourth and fifth contain the bicuspidati ; they in general possess but one depression, unlike those of the upper jaw ; the sixth and seventh possess, in general, two depressions, but sometimes three, and lodge the two anterior or great molares ; the eighth is sometimes double, sometimes single, and contains the third molar tooth or dens sapientiæ ; in structure these resemble the alveoli of the upper jaw ; the arch, however, which they form is narrower anteriorly ; it is not so regularly curved as that of the upper jaw. The *angle* of the lower jaw is that part where the body and ramus meet ; it is somewhat obtuse and rounded off posteriorly, where it gives attachment, a little on its inner surface, to the stylo-maxillary ligament ; its *outer surface*,

rough and concave, gives insertion to the masseter muscle; its *inner surface*, more rough and convex, gives insertion to the internal pterygoid muscle; above this it presents the *mylo-hyoidean groove*, which gives lodgement to the mylo-hyoid nerve and artery, branches of the inferior dental; this groove commences at the inferior dental foramen, passes downwards and forwards, and is gradually lost on the bone; it is covered by a prolongation of the internal lateral ligament. The *ramus* is that part of the lower jaw which ascends on each side backwards and outwards from the angle, and terminates superiorly by dividing into two processes the *coronoid* and *condyloid* separated by the *sigmoid notch*; it is quadrilateral in shape; its *outer surface*, rough and slightly concave, gives attachment to the masseter muscle; its *inner surface* irregular, presents nearly in its centre the *inferior dental foramen*; this enters the bone obliquely, and is the commencement of the *inferior dental canal*, an oblique canal which traverses the bone from its inner to its outer surface, communicating in its course with the alveoli, and terminates externally in the mental foramen, part of it still continuing its course under the incisor teeth, it transmits the inferior dental nerve and artery; the circumference of this foramen is irregular, and has attached to its inferior edge the internal lateral ligament of the temporo-maxillary articulation; from it descends the mylo-hyoidean groove as already mentioned; *superiorly* the *ramus* terminates in the *coronoid* and *condyloid processes*; the *coronoid process* is the anterior, it is triangular in shape, is directed upwards, backwards and outwards, and gives insertion to the temporal muscle, on its inner surface and edges, on the anterior of which it descends to near

the last molar tooth ; the outer surface of the coronoid process is covered by the masseter muscle ; its anterior edge is grooved inferiorly, and gives attachment to the buccinator muscle, inferiorly it terminates in two lines which pass on the inner and outer surfaces of the body of the bone to be continuous with the internal and external oblique lines ; the *condyloid process*, or *condyle* is the posterior, it presents itself as a convex eminence encrusted with cartilage for articulation with the glenoid cavity of the temporal bone ; it is oblique, its longest axis directed backwards and inwards, so that two lines drawn in the axes of the two condyles will meet posteriorly at the foramen magnum ; it is more elevated externally than internally ; at its very upper part it is bent slightly forwards ; its posterior surface nearly straight, is but little covered by cartilage ; at its outer extremity is a small tubercle which gives attachment to the external lateral ligament of the articulation ; inferiorly it is unequally supported by the *neck*, a contracted part of the bone which is placed so as that more of the condyle projects internally than externally, at the anterior internal part of this is a depression which receives the insertion of the external pterygoid muscle ; on its outer surface it gives attachment also to the external lateral ligament ; these two processes are separated by a deep arched excavation, the concavity directed upwards, this is the *sigmoid notch*, through it pass the masseteric vessels and nerves ; the *posterior edge* of the ramus is obtuse and corresponds to the parotid gland ; a little above its centre it is rounded off for the passage of the internal maxillary artery.

The *structure* of the lower jaw is chiefly spongy, covered by compact tissue ; it articulates only with

the temporal bones and teeth ; it is developed by two points of ossification, one for each lateral part ; to place it *in situ*, the condyles must be directed upwards, and its inferior edge or base placed nearly horizontal ; in the fœtus the lower jaw consists of two portions, afterwards united at the symphysis ; its angle is much more obtuse ; its rami pass more backwards, and its alveoli are not fully developed ; in the old subject the angle again becomes obtuse, and the alveoli absorbed, so that their vertical extent is much diminished.

SECTION III.

THE TEMPERO-MAXILLARY ARTICULATION.

This articulation, the most moveable one in the head is formed on each side by the *temporal bone* and the *inferior maxilla* ; the *temporal bone* presents for this purpose on the under surface of its zygomatic portion, the *glenoid cavity*, and the *transverse root* of the zygoma ; the *glenoid cavity* is a deep excavation, concave, directed backwards and inwards, descending lower internally than externally ; it is divided into two parts, an anterior *articular* and a posterior *non-articular* by the Glasserian fissure ; the former only of these, as its name implies, forms the articulation, and is lined by cartilage ; the *glenoid cavity* is bounded internally by the spinous process of the sphenoid bone, externally by the horizontal root of the zygoma, posteriorly by the meatus auditorius externus, and anteriorly by the *transverse root of the zygoma* ; this is an eminence, convex from before

backwards, concave from side to side, encrusted with cartilage, oblong, its longest axis directed inwards and slightly backwards; it descends lower internally than externally, and articulates with the condyle of the lower jaw when the mouth is widely opened; the part of the *inferior maxilla* which forms the articulation is the *condyle*; this is an oblong eminence situated on the upper part of the ramus of the jaw; its long axis is directed obliquely backwards and inwards, so that two lines drawn in the direction of both condyles backwards, will meet at the foramen magnum; it projects higher externally than internally, is bent slightly forwards and is encrusted with cartilage which descends farthest on its anterior surface; externally it presents a tubercle to which is attached the external lateral ligament; it is supported unequally on the *neck*, so that more of the condyle projects on the inner than the outer side; at the anterior internal part of the neck is a depression which gives insertion to the external pterygoid muscle.

THE LIGAMENTS OF THE TEMPERO-MAXILLARY ARTICULATION.

The ligaments of the tempero-maxillary articulation are the *external lateral*, the *internal lateral* and the *capsular*; in its interior it possesses an *inter-articular* cartilage, and is lined by *synovial membrane*; besides these ligaments there are the *stylo-maxillary* and *inter-maxillary*, which although not immediately connected with the articulation may be described with it.

The *external lateral ligament* is situated on the outer side of the articulation, behind the masseter muscle overlapped by a part of the parotid gland; it arises from the tubercle on the outer extremity of the

transverse root of the zygoma, passes downwards and backwards, and is *inserted* into the outer extremity and side of the condyle and neck of the lower jaw, it is a little larger superiorly than inferiorly, is about an inch in length, and is composed of dense close fibres; its *inner surface* is in contact with the synovial membrane and interarticular cartilage; its outer is covered by a part of the parotid gland; its oblique direction, backwards, permits the condyle to pass forwards on the transverse root of the zygoma when the mouth is widely opened.

The *internal lateral ligament* is situated on the inner side, and is not closely connected to the articulation; to expose it, the jaw should be sawn through at the symphysis, and everted; it *arises* narrow, and pointed from the spinous process of the sphenoid bone, passes downwards and forwards, expanding and becoming flattened as it descends, and is inserted into the lower and anterior part of the circumference of the dental foramen, sending down a prolongation which covers the mylo-hyoidean groove and nerve: this ligament is much longer than the external, but is not so dense in its structure; its *outer surface* corresponds to the synovial membrane and external pterygoid muscle, and is separated from the neck of the condyle by the internal maxillary artery, the inferior dental vessels and nerve; its *inner surface* corresponds to the internal pterygoid muscle and gustatory nerve; it is inserted into the dental foramen, that it may not interfere with the motions of the joint.

The *capsular ligament* is not to say well marked; *superiorly* it is attached to the Glasserian fissure, and round the articular surface of the glenoid cavity and transverse root of the zygoma, passes downwards,

attaches itself to the fibro-cartilage, and is inserted into the condyle of the lower jaw, beneath its articular surface; it is deficient internally, where it is perforated by the external pterygoid muscle.

The *Stylo-maxillary* ligament is a broad, thin ligament, and is by some considered to be a prolongation of the cervical fascia; it arises superiorly from the styloid process of the temporal bone, passes downwards, forwards, and outwards, and is inserted into the inner edge of the angle of the lower jaw, between the internal pterygoid and masseter muscles, and between the parotid and sub-maxillary glands; it gives origin to the stylo-glossus muscle, and has attached to it the cervical fascia; it is relaxed when the mouth is opened, stretched when shut, in order to fix the styloid process more firmly, and thus favour the action of the styloid muscles in the act of deglutition.

The *Inter-maxillary* ligament is a weak, indistinct ligament, which arises superiorly from the lower extremity of the internal pterygoid plate, descends, and is inserted into the inferior maxilla, close to the root of the coronoid process, behind the last molar tooth; it gives origin to the buccinator muscle anteriorly, the superior constrictor of the pharynx posteriorly.

On cutting into the articulation, the inter-articular cartilage and synovial membrane, will be exposed.

The *Inter-articular cartilage* is a thin plate of fibro-cartilage, placed between the bones, and separating the synovial membrane into two sacs; its *superior surface* concave from before backwards, convex transversely at its anterior and posterior parts, corresponds to the glenoid cavity; its

inferior is concave and rests on the condyle; its *circumference*, thicker than the centre, has attached to it externally the external lateral ligament; internally and anteriorly the external pterygoid muscle; posteriorly it is perforated by numerous vessels; it is sometimes perforated in the centre, and then the two synovial sacs communicate. The *synovial membrane* of the articulation is divided into two sacs by the inter-articular cartilage; the *superior* lines the glenoid cavity, the transverse root of the zygoma, and the upper surface of the interarticular cartilage; the *inferior* covers the under surface of this cartilage, passes from this on the condyle, and descends on the neck, which it covers more posteriorly than anteriorly; the two sacs communicate when the inter-articular cartilage is imperfect.

The tempero-maxillary articulation belongs to the class *Arthrosis*; its motions are *flexion*, *extension*, *lateral motion*, and *circumduction*. *Flexion* of the lower jaw is opening the mouth; in this motion, the lower jaw descends anteriorly, its angles pass downwards and backwards, and when carried to any extent, the condyles and inter-articular cartilages start forwards on the transverse root of the zygoma; it is performed by the digastric, genio-hyoid, genio-hyo-glossi, mylo-hyoid muscles, etc., depressing the jaw anteriorly, and by the external pterygoid muscle with some of the anterior fibres of the temporal drawing the condyle and inter-articular cartilage forwards, in consequence of the attachment of the former muscle to it; it is in this position of the jaw, that is, when the mouth is widely opened, (as in yawning) and the condyles rest on the zygoma, that dislocation forwards into the zygomatic fossa so

readily occurs ; this is said to be caused by the spasmodic action of the external pterygoid muscle on each side drawing the condyles suddenly forwards ; on a careful examination, however, it will be found that then, that is, when the mouth is widely opened, this muscle has lost so much of its obliquity, and its origin and insertion are so much approximated, that it cannot have much effect this way, and why this muscle, now we may say relaxed by its points of attachment being approximated, should suddenly contract, whilst all the muscles which oppose this dislocation look calmly on, we cannot understand ; we rather think the dislocation is produced by the continued action of the digastric and other muscles above enumerated, as attached to the anterior part of the jaw, or by the sudden application of force in this situation, acting by means of a most advantageous lever, a lever which will be found to be one of the first order, the fulcrum being at the insertion of the internal pterygoid and masseter muscles, the resistance at the articulation and the force in front, at the extremity of the lever ; and on reflexion, it is one of the most favourable kind, for when the mouth is widely opened, the rami of the jaw approach so much to the direction of these muscles from the condyles passing forwards, that the fulcrum is placed close to the resistance : when the mouth is *very widely* opened the jaw may be dislocated forwards by the direct action of the masseter and internal pterygoid muscles ; this results from the condyles becoming then anterior to the insertions of the muscles ; flexion may be accomplished by the weight of the jaw, without any muscular effort, as is seen in sleeping, in the dead subject, etc.

Extension is the reverse of flexion, that is, the

mouth is closed ; in it the jaw ascends anteriorly, the angles are brought forwards and upwards, and the condyles are drawn backwards into the glenoid cavity ; it is accomplished by the middle and largest portion of the temporal muscle, the internal pterygoid and the anterior portion of the masseter muscle elevating the jaw, and by the posterior fibres of the temporal and masseter drawing the condyles backwards ; these two latter, therefore, are the chief agents in preventing dislocation forwards.

Lateral motion, also called the *grinding* motion ; in this motion the lower jaw is not drawn directly from one side to the other as the term would imply, such motion being restrained by the shape of the glenoid cavity, the projection of the spinous process of the sphenoid bone internally, the coronoid process striking against the superior maxilla, etc. ; in it the condyles are drawn alternately forwards and backwards ; in this way its anterior part is alternately thrown to either side, and the molar teeth thus are enabled to grind the food. The principal muscles engaged in this motion are the two pterygoids, the anterior portions of the temporal and masseter muscles which draw the condyles forwards, and the posterior portions of the latter muscles which draw them backwards, these muscles it must be recollected, act alternately, that is, those of one side first and then the other. These two motions are widely different from flexion in the powerful muscles which produce them ; this is necessary in consequence of the unfavourable lever (one of the third order) by which they are obliged to act, and the powerful trituration necessary to reduce some substances to the consistence requisite for deglutition and digestion ; for these reasons these muscles are much more powerful in some lower tribes of animals,

who from the greater length of the lower jaw and from their carnivorous habits require much more muscular effort.

Circumduction can hardly be said to be possessed by the lower jaw, it is rather a successive action of all the preceding motions; perfect circumduction being prevented by the shape of the condyles.

The centre of motion, in flexion and extension corresponds to the dental foramina; in lateral motion rather between these foramina; in circumduction sometimes in, sometimes between them; hence the vessels and nerves of the lower jaw enter in this situation that they may not be stretched in these motions. The lower jaw may be drawn directly forwards so as to project beyond the upper jaw anteriorly, by the action of the pterygoid muscles, and the anterior fibres of the temporal and masseter.

Dislocation does not occur in the young subject from the oblique direction of the rami upwards and backwards, and from the angles consequently being so obtuse: the chin in them will touch the sternum before the relative bearings of the condyles and muscles could be such as to allow of displacement; the centre of motion in the child is in the condyles, as is also the case in the old subject; at both these periods of life the motions of this articulation are not so perfect as in the adult, being almost confined to flexion and extension.

SECTION IV.

THE TEETH.

The teeth are small bones of a very hard and compact structure placed in the alveoli of the upper

and lower jaw ; their number is almost constantly thirty-two, sixteen in each jaw, but varies in some individuals, being sometimes but twenty-eight or thirty, in others exceeding that number ; each tooth consists of a *body* or *crown*, a *neck* and a *fang* or *fangs* ; the *body* or *crown* of the tooth is the upper expanded portion which is exposed, destitute of periosteum and covered by enamel ; the *neck* is the contracted part immediately beneath the body, and which is surrounded by the gums ; the *fang* or *fangs* are those processes which are sent down into the alveoli, and by means of which the teeth are firmly held in situ ; each tooth contains in its interior a canal which commences at the root of the fang by a very minute aperture, and from this passes up into the body where it is largest ; this cavity assumes the shape of the tooth, and possesses a distinct process in each fang that it may possess ; it is smooth internally and contains a soft membrane and pulpy substance, termed the *pulp* of the tooth ; this is endowed with vessels and nerves, although the latter cannot be traced into the body or crown ; the crown of the tooth is uncovered by periosteum, but the remaining parts possess this covering from the neck downwards ; this is connected also to the socket of the tooth which it lines ; at the neck it is firmly attached to the gums.

The *teeth* of each jaw are divided into four *incisors*, two *cuspidati* or canine, four *bicuspidati*, and six *molars* or *grinders*.

The *incisors* are placed in the centre of the jaws and are the only teeth whose body is flattened ; the *anterior* surface of the crown or body is convex, and directed almost vertically ; its *posterior* is concave and slopes forwards, they are wide at the cutting edge,

and contract towards the neck ; the side is, on the contrary, narrow at the cutting edge, thicker towards the neck ; the fang is single and marked laterally by a longitudinal groove ; it is flattened in a contrary direction to the crown, that is, laterally, whilst its anterior and posterior surfaces are narrow, it terminates in a point ; the *enamel* is thickest anteriorly, next posteriorly, and least thick and extensive laterally ; the incisors of the upper jaw are larger than those of the lower ; the two middle are the largest, their fangs are rather rounded, and they project more in front so as to overlap the under ones, the middle incisors of the lower jaw are the smallest, the lateral ones the largest ; the middle incisors of the upper jaw cover the middle of the lower, and one-half of the lateral ; the lateral of the upper jaw cover the remaining half of the lateral, and more than half of the cuspidati, of the lower jaw.

The *cuspidati* or *canine teeth*, are placed one on each side external to the incisors, they are thicker and stronger than them ; they possess a large and long fang which causes a remarkable prominence on the outer surface of the alveoli, and extends deep into the bone ; their *body* or *crown* is conical, the apex free, it is convex and projects anteriorly beyond the other teeth, particularly in the lower jaw ; the *fang* is compressed laterally, and is marked by a deep groove which sometimes divides into two, towards its extreme point ; the enamel which covers them is thicker than that of the incisors, and extends more on the sides ; those of the upper jaw are much larger than those of the lower ; their fangs project higher in the superior maxilla than any of the other teeth, hence they are sometimes called the *eye teeth* ; the free extremity corresponds to the interval between

the lateral incisors and the first bicuspid of the lower jaw.

The *bicuspidati* or small molars are placed two on each side, between the preceding and the molares they are smaller than the cuspidati, and resemble one another very much; the first being in general a little smaller than the second although possessing the longer fang; the *body*, long from before backwards, compressed laterally, terminates in two tubercles separated by a depression; the anterior of these is the larger and more projecting, and nearly conceals the other; as it approaches the fang it becomes smaller, and has its enamel terminating equally all round; the fang is broad and compressed, deeply grooved laterally, and terminates sometimes, and more frequently in the upper jaw, in a double fang; those of the upper jaw are broader and flatter than those of the lower; their fangs contain a double cavity, even when a single one exists, one towards each margin; the first upper bicuspid corresponds to the interval between the bicuspids of the lower jaw, the second rests on the second lower bicuspid and the first molar; they project but little beyond the lower; these teeth are more frequently wanting than any other, except the *dentes sapientiæ*.

The *molares* or *grinders*, are placed three on each side, external and posterior to the preceding; the first and second resemble one another, the third differs from these; they are the largest of the teeth, possess the greatest number of points or prominences on their body, and the greatest number of fangs; their *body* or *crown* is commonly marked by five prominences, (although it sometimes possesses but four or even three,) three external and two internal; the external of these are the most projecting

and least on a line with the surface of the tooth ; these prominences form in the centre of the tooth an irregularly depressed surface ; the body contracts but little towards the neck, and terminates by dividing into two, three, four or five fangs, most frequently three, two being external and one internal, all of which possess an opening at their summit leading into the cavity of the tooth ; the enamel lines more of the free than their lateral surfaces. The *first* molar tooth is the largest and strongest ; its crown possesses five tubercles or prominences arranged as above mentioned ; its fangs in the upper jaw are three in number ; most frequently, two external and one internal ; it sometimes possesses four or five ; the fangs of this tooth in the lower jaw are most frequently double, and are placed across the alveoli, so that one is posterior to the other ; each fang possesses two cavities, one near each edge. The *second* molar tooth is a little smaller than the preceding ; its crown possesses but four tubercles in the lower jaw ; its fangs are as the preceding, three in the upper, two in the lower jaw ; the external fangs of both teeth are nearly vertical, whilst the internal, stronger, diverges from them internally so as to afford considerable resistance to the extraction of the tooth and frequently to cause a fracture of the alveoli ; the *third* molar tooth is the smallest and most irregular ; its crown possesses three or four tubercles, it possesses one, two or three fangs, most frequently one in the lower jaw ; they are shorter than those of the preceding and do not diverge to the same extent ; they are directed forwards so as to support the second molar tooth ; this tooth in the upper jaw is smaller than that of the lower, hence each row of teeth meet exactly at the posterior extremity ;

the last molar teeth have received the name of *dentes sapientiæ*, from their not appearing till the age of twenty or twenty-one ; they decay shortly after their appearance and are often wanting.

The *structure* of the teeth is composed of two materials, a *bony* portion and a remarkably dense structure, termed the *enamel* ; the bony portion forms the whole of the tooth, except its external surface where it is exposed to friction, and is here, therefore, covered by enamel ; although termed bone, it differs so much from the osseous structure in general that some anatomists have considered it to bear much resemblance to ivory ; it is much more dense and compact than any other bony substance, but not so hard as the enamel ; its fracture has a fibrous appearance, the fibres being disposed in laminæ, running from the apex of the fang to the base or cutting surface of the tooth ; it does not contain reticular tissue or medullary cells ; it is however composed of animal and earthy substance as bones are.

It is a disputed point whether the bony part is vascular or not, Mr. Hunter considered it not to be so ; the arguments against its vascularity are very numerous, viz : when it is fractured or injured in any way, such injury is never repaired ; it cannot be injected ; it does not participate in the diseases of the constitution ; is not coloured by madder root as other bones are, unless when being deposited, and when once tinged the colour is never afterwards removed ; it is much more useful by not being vascular, as when the enamel is removed it becomes exposed to friction ; no nerves can be traced into it, as both vessels and nerves terminate in the pulp in the cavity of the tooth : notwithstanding, it would

appear that it does possess some degree of vascularity, as it is liable to exostosis and other diseases; its earthy matter consists principally of phosphate, carbonate and *fluat*e of lime, its animal of gelatine.

The *Enamel* is that white substance which covers the teeth where they are exposed, it is remarkably dense and compact and is the hardest structure in the human body, striking fire with steel, it is of a milk white colour, and is capable of a high degree of polish; it appears to be one uniform mass, but is composed of fibres which are placed perpendicularly, some to the centre, and some to the surface of the bony portion in order that they may better resist the effects of friction, it is thickest where most exposed; the enamel is not vascular, and is perhaps the least organised structure in the living body; its chemical composition is the same as that of the bony portion, except that it contains much more fluat of lime and less animal matter.

GROWTH OF THE TEETH.

The lower jaw and alveolar processes are very early developed in the foetus, being called into exercise immediately after birth. About the third or fourth month of foetal life there exists in each jaw, instead of alveoli, a longitudinal groove, deep and narrow anteriorly, shallower and wider posteriorly, divided by bony ridges into superficial depressions, along the bottom of which run the dental vessels and nerves; after a short time, processes are sent across from one edge of the groove to the other, so as to completely divide it into distinct cavities, and form the alveoli; these grow with the teeth, or even advance more rapidly, and at last nearly enclose them, becoming contracted towards their mouths;

they are more rapidly formed anteriorly than posteriorly; in these depressions, about the third or fourth month, soft vascular substances, termed *pulps*, begin to be formed, on which the bony part of the tooth is afterwards to be deposited; they are not distinct so early, but become so about the fifth month, when four or five pulps are manifest; the pulps of those teeth which appear first are first formed, viz: the middle incisors first, then the lateral incisors and small grinders, and last the cuspidati and large grinders, no bicuspid existing in the temporary teeth; each pulp, in shape, resembles the body of the tooth which is to be formed on it, it is soft and vascular, particularly where it is in contact with the part of the tooth deposited, so much so, that it may be here deeply coloured with injection; on the free surface of the pulp, ossification commences by as many points as there are prominences on each tooth, there being three in the incisors, one in each of the cuspidati, four or five in the molars, and two in the bicuspid when they are forming; these different points afterwards coalesce; the ossification proceeding from without inwards, that part which is first formed is the most external, and is in contact with the enamel; in this way ossification proceeds, until it is so far advanced that it contracts the size of the pulp, and at last completely surrounds it, except at its base, leaving, in this manner, the cavity already described as existing in each tooth; the adhesion of the pulp to the newly formed tooth is but slight, as they can be easily separated without injuring any apparent vascular connexion; at first the *body* of the tooth alone is formed, when this is completed it begins to contract, and becomes somewhat rounded, forms the neck, and from this then the fang or fangs commence;

these form by the elongation of the pulp, and the deposit of bony matter on it, and at last increase to such an extent as to cause the elevation of the body of the tooth above the gum, the alveoli at the same time contracting so as to embrace the fang ; as ossification proceeds, the extremity of the ossified part is thin, elastic, and transparent, and has received the name of *substantia cornea* ; when one fang alone is formed, the pulp sends down but one process ; when two or more fangs are to be formed, a like number of processes elongate from the body of the pulp, which are afterwards separated by bony partitions, sent across from the bony margin of the cavity in the body of the tooth. When the tooth first appears through the gum, it is very imperfect in structure, its fang is but badly developed, and its cavity is large. In this way the bony part of the tooth is formed on the pulp, but how deposited is not perhaps to be explained.

The *enamel* is deposited in a different manner ; for this purpose the pulp is enclosed by a membrane, divided into as many bags or cells as there are teeth forming at the time ; they are of a whitish appearance externally, but very vascular internally, and are termed the *capsules*. It is the inner surface of these which secretes the enamel, its outer surface adhering firmly to the gum. This membrane deposits the enamel shortly after the tooth begins to be formed, in greatest quantity where most is required, as mentioned in the description of the teeth ; it is at first soft, moist, and rough, but when it has acquired the full degree of thickness, it assumes its natural shining and polished appearance ; it is completed when the tooth appears through the gum. At this time the capsule having performed its office loses its vascularity, becomes absorbed so as to allow of the

exit of the tooth, and finally descends so as to form the periosteum of the fang and becomes adherent to it.

The teeth which are first formed, and which appear shortly after birth are termed the *temporary* or *deciduous* teeth, because, at about the age of seven or eight, they fall out, and are replaced by the *adult* or *permanent* set ; this contrivance was necessary, inasmuch, as the teeth do not possess in themselves the power of growth ; a new set therefore is formed to be the better adapted to the wants of the adult and the size of the jaw ; there are ten *temporary* teeth in each jaw, four incisors, two cuspidati, and four molares or grinders ; they contain no bicuspidati ; they resemble the adult teeth, except that they are much smaller ; the time at which they cut through the gum is variable, they, in general, appear in the following order, commencing generally about the fifth, sixth, or seventh month after birth ; the *middle incisor* of the under jaw ; the *middle* of the upper ; the *under lateral incisors* ; the *upper lateral incisors* ; *anterior molars or grinders* of under jaw ; *anterior* of upper ; the *cuspidati* and first those in the lower jaw ; the *posterior* or *larger* grinders ; their appearance is completed about the second or third year, some weeks or months generally elapsing between each set.

The formation of the *permanent teeth* is precisely the same as that of the temporary, viz : by the production of pulps and capsules ; the pulps which form them are derived from those of the temporary teeth which send prolongations or processes backwards from their posterior surface for their formation, with the exception of the permanent molares, which, from having no temporary teeth to correspond to, the bicuspid taking the place of the temporary molares, are produced from pulps formed for them, and which

have no connexion, as is generally thought, with the pulps already formed. The connexion between the pulps of the temporary and permanent teeth is at first intimate, being both contained in the same socket; according as they advance, however, they separate, and the permanent teeth are lodged in distinct bony cells which are situated below and behind the temporary cells in the inferior maxilla; above and behind them in the superior; ossification has commenced on them about the age of six or seven months, and their formation is considerably advanced when the temporary incisors have appeared, they gradually increase in size until the temporary teeth are shed to make room for them, by the gradual absorption of their fangs, and the consequent loss of connexion with the alveoli; the *dentes sapientiæ* being the last formed, not commencing till the eighth or ninth year. From the preceding description it may be seen that the number of teeth formed and forming in the jaws at different periods, is variable; at the time of birth, each jaw contains the rudiments of the ten temporary teeth, the anterior adult molares and incisors, if not cuspidati; the greatest number exists about the age of six years, just before the shedding of the temporary set, each jaw then containing twenty-four teeth, viz: both the temporary and permanent set, except the *dentes sapientiæ*; and in some cases these also; the permanent teeth do not appear in the same order as the temporary; the *anterior molares* appear first, then the *middle lower incisors*; next, the *middle* of the *upper* jaw, after these the *lateral incisors* appear, and first those of the *lower* jaw; the temporary molares are shed before the *cuspidati*, and their place supplied by the *bicuspid*s; shortly after these, and frequently before the appearance of the second *bicuspid*

the *cuspidati* appear ; the *middle permanent molares* appear next, and the *dentes sapientiæ* last of all not appearing till the age of nineteen, twenty, or twenty-one.

SECTION. V.

THE OS HYOIDES.

The *Os-Hyoides* is placed in the anterior and upper part of the neck, having no osseous connexion with any other bone, between the tongue above and the larynx beneath ; it is somewhat arched, convex anteriorly, concave posteriorly, and is divided into *body*, *cornua* and *appendices* ; the *body* occupies the central part and is the largest ; it is quadrilateral ; its *anterior surface* irregular and convex, is divided by a horizontal ridge most prominent in the centre, into two portions, which are subdivided into two on each side by a vertical ridge ; these give attachment from below upwards to the digastric, stylo-hyoid, mylo-hyoid, genio-hyoid and hyo-glossus muscles ; its *posterior surface* smooth and concave corresponds to a quantity of yellow cellular tissue, which separates it from the epiglottis ; its *inferior edge* gives attachment anteriorly to the sterno-hyoid, omo-hyoid and thyro-hyoid muscles ; and behind these to the thyro-hyoid ligament : its *superior edge* gives origin to the hyo-glossus muscle ; at either *extremity* it prevents a convex cartilaginous surface by which it is joined to the cornua. The *cornua* are two in number, one on each side, they are longer but not so strong as the body ; at their anterior extremity they are marked by a concave articular surface, where they are connected to the body ; from

this they pass upwards and backwards, becoming gradually smaller and terminate in a small round head covered by cartilage; *superiorly*, they give attachment to the hyo-glossus and middle constrictor of the pharynx; *inferiorly* to the thyro-hyoid membrane; *externally* to the thyro-hyoid and digastric muscles; *internally* they are covered by the mucous membrane of the pharynx; the *appendices or lesser cornua*, are pyramidal in shape; they pass upwards and backwards from near the junction of the body and great cornua and terminate posteriorly in a point; they give attachment inferiorly to the genio-hyo-glossus muscle; *superiorly* to the stylo-hyoid ligament; the *structure* of the os-hyoides is chiefly spongy; the cornua possess more compact tissue; it is developed by five points of ossification, one for each of its pieces, which in advanced life become united so as to form but one bone.

The *articulations* of the os-hyoides consist of those between its different pieces just described, and which possess unimportant ligaments and are covered by synovial membrane; they disappear in advanced life; it is connected to the temporal bone by means of the following ligament: The *stylo-hyoid ligament* arises narrow and pointed from the styloid process of the temporal bone, descends forwards and inwards, becoming expanded, and is inserted into the lesser cornu of the os hyoides; it is exceedingly variable as to size and is sometimes converted into bone, when the styloid process appears to be elongated as far as the os-hyoides.

END OF PART FIRST.

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